DOCUMENT RESUME

ED 235 328 CE 037 110

AUTHOR Finnerty, Kathy

TITLE Auto Mechanics. Heavy Equipment. Small Engines.
INSTITUTION Oswego County Board of Cooperative Educational Services, N.Y.
SPONS AGENCY New York State Education Dept., Albany.
PUB DATE [82]
NOTE 299p.
PUB TYPE Guides - Classroom Use - Materials (For Learner) (051)

EDRS PRICE MF01/PC12 Plus Postage.
DESCRIPTORS *Auto Mechanics; *Engines; *Equipment Maintenance; Equipment Utilization; Learning Activities; *Operating Engineering; Postsecondary Education; Study Guides; Trade and Industrial Education; Workbooks
IDENTIFIERS Automotive Cooling Systems; Automotive Electrical Systems; Automotive Fuel Systems; *Heavy Equipment Mechanics; Heavy Equipment Operators; *Small Engine Repair

ABSTRACT

Developed for use in auto mechanics, Heavy Equipment Repair and Operation (HERO), and small engines programs, these study guides and supplemental worksheets cover operating principles, lubrication, cooling system, ignition circuit and electrical system, and fuel system. The worksheets and guide questions are phrased to emphasize key points designated by the program instructor and to aid in evaluating the technical information presented within the curriculum area. Although some worksheets specifically state that they were written for a particular specialized occupational program, they may be modified or adapted for use in other mechanical clusters. Specific contents include reading modules (vocabulary, informational material, questions, and answer keys) on operating principles, lubrication, fuel systems, carburetors, and carburetor circuits; worksheets of various types, including short answer, true-false, matching, multiple choice, identification, and cloze exercises. A separate section contains exercises in micrometer reading, mathematics and vocabulary. Study guides are also provided for use with the "Small Gas Engines" textbook. The final section contains cloze exercises. All answer keys are included. (YLB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

81-37-9116S

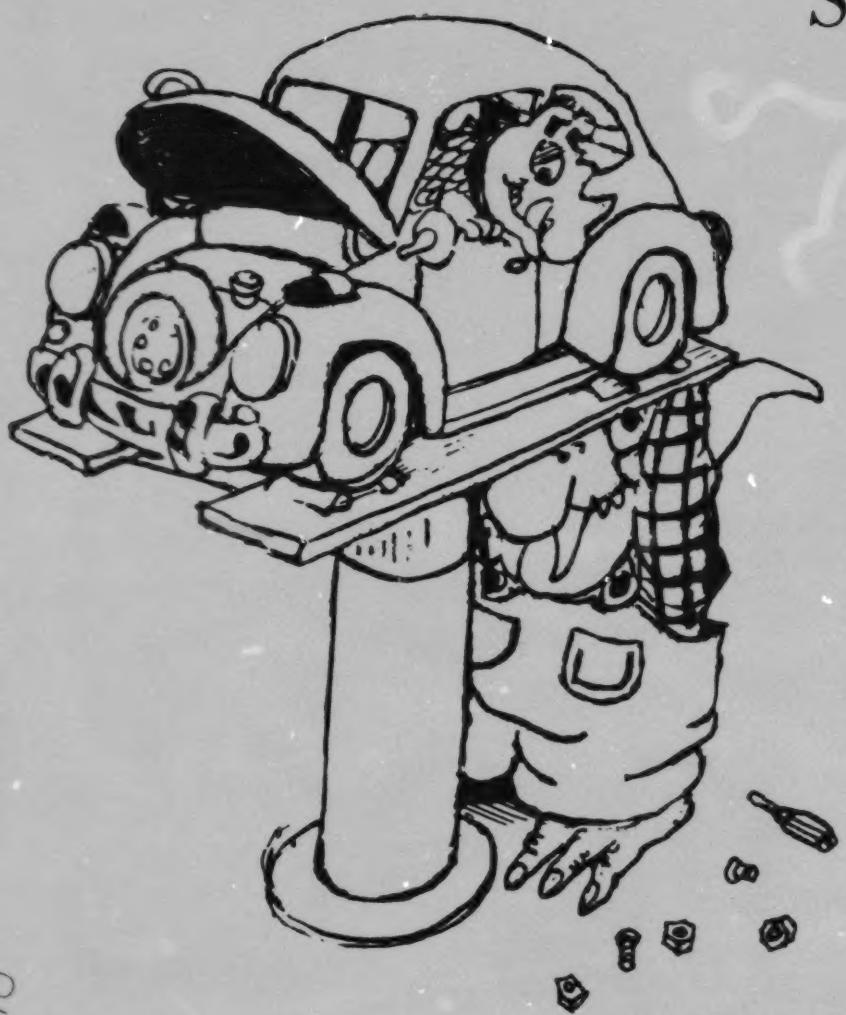
NY48213/03

ED235328

Auto Mechanics

Heavy Equipment

Small Engines



U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.

Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

R Finnerty

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Kathy Finnerty
Resource Coordinator
Oswego County BOCES
Occupational Resource Center

CE037110

Preface

The enclosed study guides and supplemental worksheets were developed for use in three areas: Auto Mechanics, HERO-Heavy Equipment Repair and Operations, and Small Engines. The worksheets and guide questions herein were phrased to emphasize key points designated by the program instructor and to aid in evaluating the technical information presented within the curriculum area. Although some worksheets specifically state they were written for a particular specialized occupational program, they may be modified or adapted for use in other mechanic clusters.

The worksheets presented herein may be reproduced for use with students.

Kathy Finnerty
Resource Coordinator
Oswego County BOCES
Occupational Resource Center

Operating Principles

PAGE 1

OCCUPATIONAL READING MODULES

OSWEGO COUNTY B.O.C.E.S.

STATE PROJECT #81-3A-9111GS

PROGRAM COORDINATOR:

KATHY FINNERTY

AREA CONSULTANT:

GEORGE BELL

PROGRAMMERS:

JIM HURD

MARY KAY MCGIFF

****

AGE 2

OPERATING PRINCIPLES

VOCABULARY

STROKE

INTAKE STROKE

AIR-FUEL MIXTURE

PISTON

CONNECTING ROD

CYLINDER

TOP DEAD CENTER (TDC)

BOTTOM DEAD CENTER (BDC)

PAGE 3

VOCABULARY (CONTINUED)

COMPRESSION STROKE

CONTROLLED

IGNITE

SPARK PLUG

EXPLOSION

EXHAUST STROKE

EXHAUST VALVE

REPEATED

****

AGE 4

THERE ARE FOUR STROKES IN EACH RUNNING CYCLE OF THIS ENGINE. THEY ARE: INTAKE, COMPRESSION, POWER AND EXHAUST.

EACH CYLINDER HAS TWO OPENINGS WHICH CAN BE OPENED OR CLOSED BY VALVES. ONE OPENING LETS AIR AND GAS IN. THIS IS CONTROLLED BY THE INTAKE VALVE.

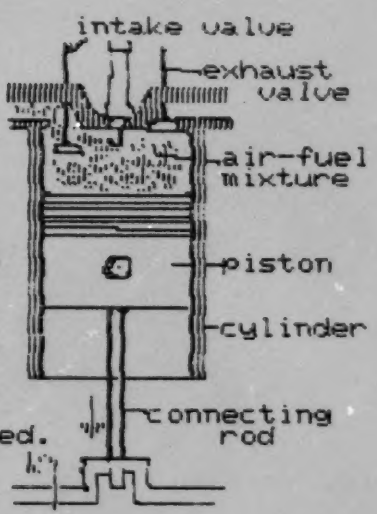
PAGE 5

THE SECOND OPENING LETS AIR AND GASES OUT. THIS IS THE EXHAUST VALVE. THESE VALVES MUST OPEN AND CLOSE AT THE RIGHT TIME FOR THE ENGINE TO RUN.

****

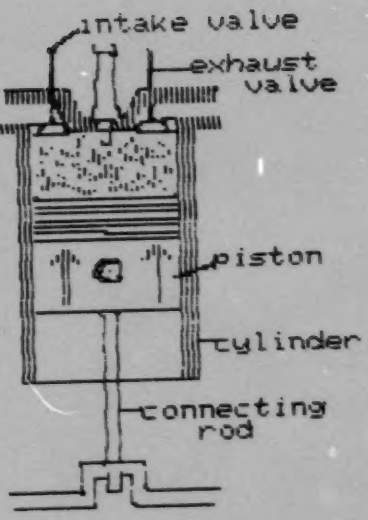
AGE 6
IGURE 1

On the intake stroke (TDC to BDC) the piston moves down and pulls air and gas into the cylinder as the intake valve opens. The exhaust valve stays closed.



PAGE 7
FIGURE 2

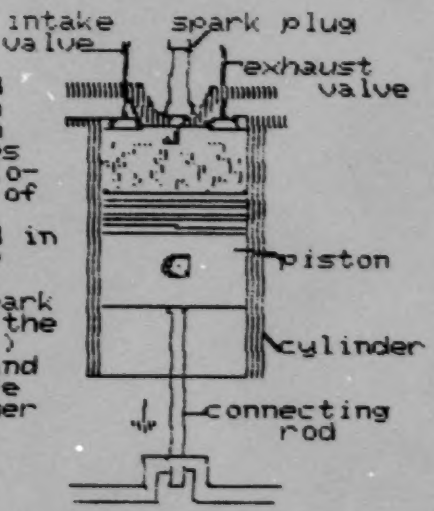
On the compression stroke, the piston moves up, BDC to TDC, and squeezes the air and gas mixture. Both intake and exhaust valves are closed.



****

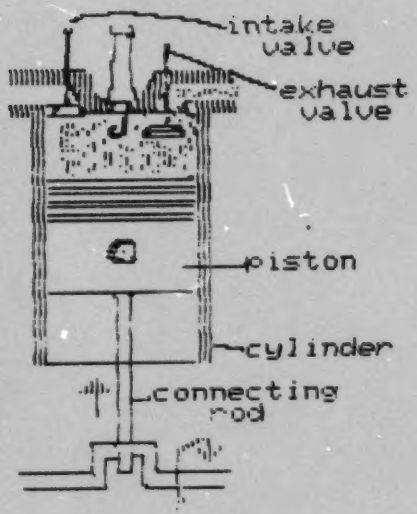
PAGE 8
FIGURE 3

On the power stroke, the air and gas is burned and the explosion pushes the piston down which creates power. (This explosion, at the end of the compression stroke, is caused in a gasoline engine by a spark that comes from the spark plug and ignites the air-fuel mixture.) Both the intake and exhaust valves are closed on the power stroke.



PAGE 9
FIGURE 4

On the exhaust stroke the piston moves up and pushes out the burned gases through the open exhaust valve. The intake valve is closed.



****

PAGE 10

1. THE PART OF THE ENGINE THAT OPENS OR CLOSES THE OPENINGS IN THE CYLINDER IS THE -----.

   A. PISTON

   B. CYLINDER

   C. CRANKSHAFT

   D. VALVE

PAGE 11

2. WHEN THE INTAKE VALVES ARE OPEN AND THE EXHAUST VALVES ARE CLOSED, THE PISTON SHOULD BE MOVING DOWN ON THE --- STROKE.

   A. INTAKE
   B. COMPRESSION
   C. POWER
   D. EXHAUST

3. WHEN THE EXHAUST VALVE IS OPEN AND THE INTAKE VALVE IS CLOSED THE PISTON SHOULD BE MOVING ON THE --- STROKE.

   A. INTAKE
   B. COMPRESSION
   C. POWER
   D. EXHAUST

****

PAGE 12

4. WHEN BOTH VALVES ARE CLOSED AND THE PISTON IS MOVING DOWN IT IS ON THE -- STROKE.

   A. INTAKE
   B. COMPRESSION
   C. POWER
   D. EXHAUST

5. WHEN BOTH VALVES ARE CLOSED AND THE PISTON IS MOVING UP IT IS ON THE --- STROKE.

   A. INTAKE
   B. COMPRESSION
   C. POWER
   D. EXHAUST

PAGE 13

	ANSWERS	PAGE REF.
1	D	4
2	A	6
3	D	9
4	C	8
5	B	7

PAGE 1

DIESEL ENGINE

VOCABULARY

DIESEL ENGINE

CYLINDER

TOP DEAD CENTER (TDC)

BOTTOM DEAD CENTER (BDC)

EXPANDS

PRESSURE

INJECTOR

EXPLOSION

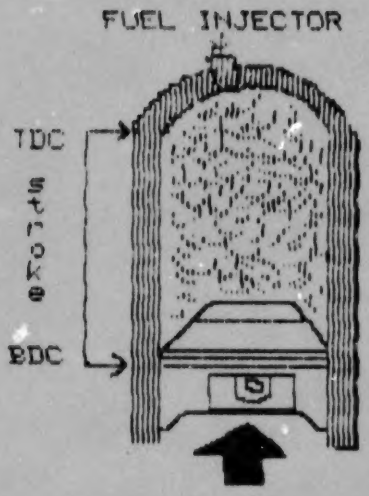
STROKE

****

PAGE 2

THE DIESEL ENGINE IS SIMILAR TO THE GAS ENGINE EXCEPT IT STARTS THE EXPLOSION, AND BRINGS FUEL INTO THE CYLINDER IN A DIFFERENT WAY.

PAGE 3
FIGURE 1



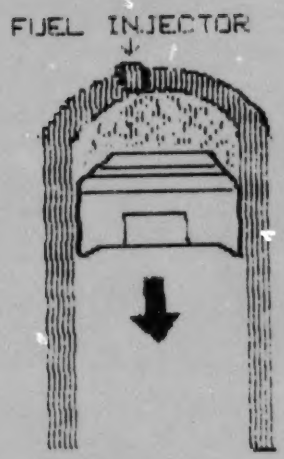
Diesel engines have a large stroke (distance from BDC to TDC), which allows more air into the cylinder.

****

PAGE 4

THE AIR IS SQUEEZED, CAUSING HIGH PRESSURE, AND A HOT AIR TEMPERTATURE. WHEN THE PISTON IS AT TOP DEAD CENTER (TDC) AND DIESEL FUEL IS SPRAYED INTO THE CYLINDER, WITH THE VERY HOT AIR, IT EXPLODES AND EXPANDS. THIS CAUSES THE PISTON TO BE PUSHED DOWNWARD.

PAGE 5
FIGURE 2



INJECTION

The diesel engine uses an injector to spray the diesel fuel into the cylinder.

****

PAGE 6

THE INJECTOR SPRAYS THE FUEL IN TINY PARTICLES WHICH ENTER THE CYLINDER LIKE A MIST. THIS MIST BURNS RAPIDLY WHEN HEATED TO A HIGH TEMPERATURE IN THE CYLINDER, WHICH CREATES AN EXPLOSION AND CAUSES THE POWER STROKE OF THE ENGINE.

PAGE 7

1. THE DIESEL ENGINE HAS MORE PRESSURE IN THE CYLINDER BECAUSE THE --- IS LARGER.

   A. PISTON
   B. VALVES
   C. CRANKSHAFT
   D. STROKE

2. HEAT IS CAUSED IN THE CYLINDER WHEN ----.

   A. AIR IS SQUEEZED VERY TIGHTLY
   B. SPARK PLUG SPARKS
   C. VALVE OPENS
   D. VALVE CLOSES

****

PAGE 8

3. FUEL IS SPRAYED INTO THE CYLINDER IN A MIST BY THE ---.

   A. VALVE
   B. INJECTOR
   C. PUMP
   D. PISTON

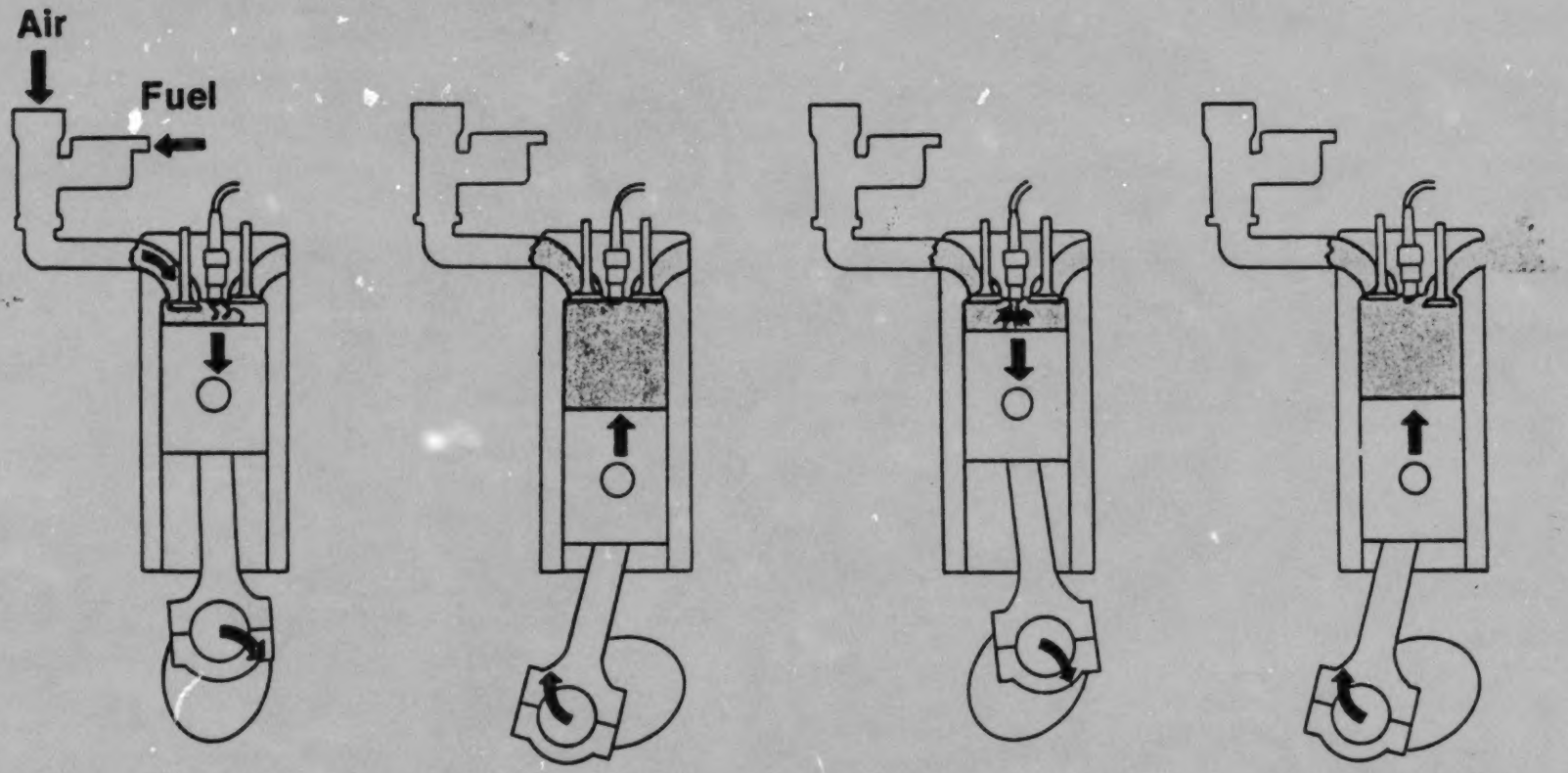
4. THE SPRAY MUST BE SPRAYED IN A MIST SO THAT THE FUEL WILL BURN --.

   A. SLOWER
   B. FASTER
   C. COMPLETELY
   D. FULLY

PAGE 9

	ANSWERS	PAGE REF.
1	D	3
2	A	4
3	B	5
4	B	6

FOUR-STROKE CYCLE ENGINE



INTAKE

Fuel-Air Mixture Drawn Into Cylinder From Carburetor Through Open Intake Valve By Down-Stroke Of Piston.

COMPRESSION

Mixture Is Compressed By Up-Stroke Of Piston. Both Intake and Exhaust Valves Closed.

POWER

Compressed Mixture Is Ignited By Spark Plug and Expanding Gases Force Piston To Bottom Of Cylinder. Valves Remain Closed.

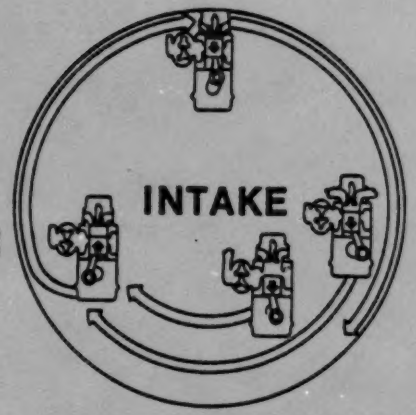
EXHAUST

Piston On Up-Stroke Forces Burned Gases From Cylinder Through Open Exhaust Valve.

John Deere, Inc.

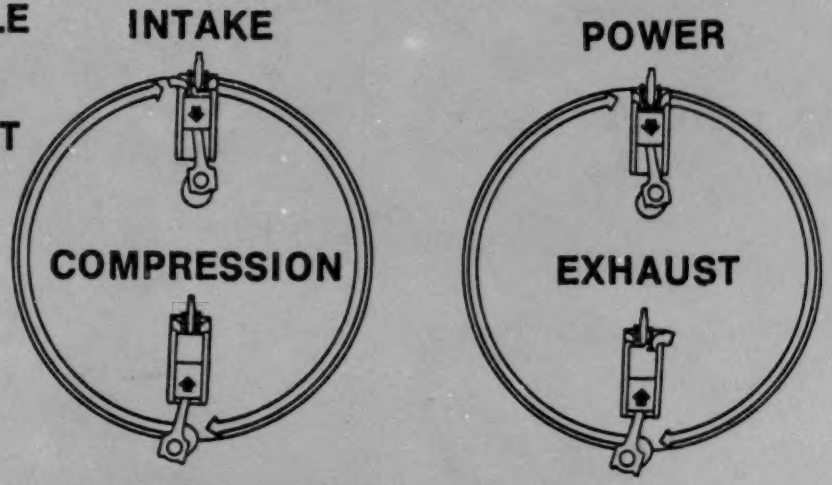
ENGINE CYCLES

COMPLETE CYCLE IN ONE REVOLUTION OF CRANKSHAFT



TWO-STROKE CYCLE

COMPLETE CYCLE IN TWO REVOLUTIONS OF CRANKSHAFT



FOUR-STROKE CYCLE

John Deere, Inc.

READING SELECTION H: AUTO MECHANICS

Source Unknown

H–3

An engine has four main systems. These systems are the fuel, ignition, cooling, and lubricating systems. The fuel system pumps gas to the engine and mixes it with air. The mixture is compressed. Then an electric spark from the ignition system ignites the fuel. The burning fuel gives the engine its power. The cooling system keeps the engine from overheating. The lubricating system pumps oil to the moving parts of the engine.

1. Technical names of the four systems are used. A description of each technical process is included. What important technical information about each system is *not* provided?

_____

_____

_____

_____

2. The context clue which explains the meaning of "ignition" is found in sentence 6.

   a. The word _____ tells what happened to the fuel.

   b. Therefore "ignite" means to _____

3. Which sentence indicates a danger that might occur when an engine is running?

_____

H–1

An internal combustion engine has four main systems. The *fuel system* carries gas to the carburetor and into the combustion chamber. The carburetor mixes the fuel with air. The mixture is compressed in the combustion chamber. An electrical spark from the *ignition system* ignites the fuel. The burning fuel provides the energy which drives the engine. The *cooling system* keeps the engine at operating temperature. The *lubricating system* pumps oil to the moving parts of the engine.

4. What information in sentence 2 was not in H-3?

_____

_____

_____

5. The word "energy" in sentence 6, H-1, is a technical term for _____ in H-3.

6. The term "compressed" is similar to the word "pressure." This would be a clue to the size of the combustion chamber. The chamber is probably (large, small). Circle one word to complete the sentence.

7. H-1 deals with the *internal combustion engine.* You can safely conclude that

_____ a. all engines are of the internal combustion type.

_____ b. all internal combustion engines operate with similar systems.

_____ c. gas is the only fuel used in an internal combustion engine.

H

An internal combustion engine uses four main systems for changing chemical fuel into mechanical energy. The fuel system includes all the components which carry gas from the gas tank to the carburetor, mix the fuel and air, and send the mixture into the combustion chamber where it is compressed and ignited. The ignition system provides an electric spark which ignites the fuel-air mixture. The cooling system maintains the combustion chamber at its operating temperature, and the lubricating system provides a flow of oil to the moving parts of the engine.

8. What purpose is served by the new technical information in sentence 1?

_____

_____

_____

9. The mixture of fuel and air is described in this selection. What do the passages assume you know in reference to the air?

_____

_____

_____

10. What is difficult about the structure of sentence 2?

_____

_____

_____

11. What makes sentence 4 difficult?

_____

_____

_____

SMALL ENGINES - OPERATING PRINCIPLES

Write the word true or false before the statement.

_____1. 2 stroke engines produce less power than 4 stroke engines of equal size.

_____2. The piston moves down on the compression stroke.

_____3. The intake valve is open on the compression stroke.

_____4. The crankshaft rotates two times to complete a full cycle in a 4 cycle engine.

_____5. The spark plug always fires when the piston is exactly at TDC.

_____6. The cam turns two times as fast as the crankshaft in a 5 cycle engine.

_____7. The valves are lapped in the seats to make them seal better.

_____8. The valve clearance is measured between the valve stem and the valve lifter.

_____9. To cut the valve seats, they are removed and placed on a machine.

_____10. Valves are held in place with springs and valve retainer locks.

_____11. Valve faces are recondioned by putting them in a valve refacer.

_____12. Ring and gap on all new rings do not have to be checked.

_____13. A plastigage is used to determine clearance between the connecting rod bearing and its journal.

_____14. Connecting rod bolts are torqued.

_____15. There is a mark on the crank gear to determine proper timing.

_____16. The connecting rod is fastened to the camshaft.

SMALL ENGINES - OPERATING PRINCIPLES

ANSWERS

1. false
2. false
3. false
4. true
5. false
6. false
7. true
8. true
9. false
10. true
11. true
12. false
13. true
14. true
15. true
16. false

NAME _____ DATE_____

4-STROKE CYCLE ENGINE

MATCH THE WORD WITH ITS CORRECT DESCRIPTION.

1. TDC_____
2. BDC_____
3. piston_____
4. cylinder_____
5. valve_____
6. connecting rod_____
7. spark plug_____
8. intake_____
9. compression_____
10. power_____
11. exhaust_____

A. It moves up and down in the cylinder.

B. The forcing together of air and fuel by the piston in the cylinder.

C. A rod that connects the piston or cylinder to the crankshaft.

D. Top Dead Center, a position of the cylinder.

E. Forcing the used air and fuel mixture out of the cylinder.

F. This moves up and down. It acts like a plug that moves to open and close. It allows fuel and air to come into the cylinder and leave the cylinder.

G. Allowing the fuel and air mixture into the cylinder.

H. Bottom Dead Center, a position of the piston in the cylinder at the very bottom of the cylinder.

I. The piston moves up and down in it, the fuel and air mixture go into this.

J. It gives the spark that ignites the fuel air mixture.

K. The stroke that the spark plug fires in.

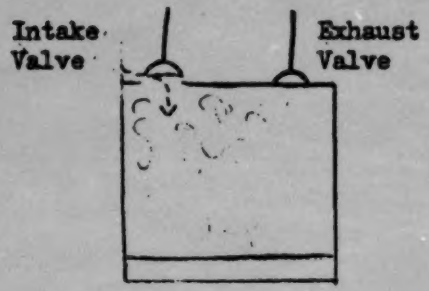
ANSWERS

4-STROKE CYCLE ENGINE

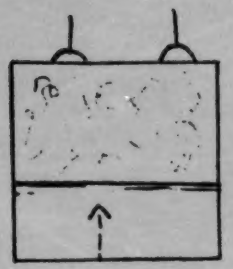
1. D
2. H
3. A
4. I
5. F
6. C
7. J
8. G
9. B
10. K
11. E

4-STROKE CYCLE ENGINE

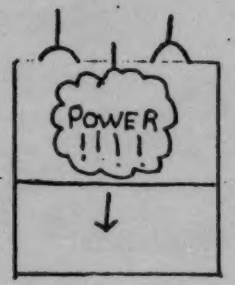
1. Intake Stroke



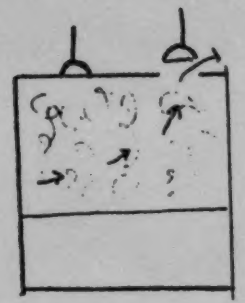
2. Compression Stroke



3. Power Stroke



4. Exhaust Stroke



1. On the intake stroke
   a. the intake and exhaust valves are closed.
   b. the intake and exhaust valves are open.
   c. the intake valve is open, the exhaust valve is closed.

2. 1. Valve _____
   2. Intake _____
   3. Compression _____
   4. Power _____
   5. Exhaust _____
   6. Cylinder _____

A. The pushing together of air and fuel mixture
B. The place the air and fuel go in.
C. A plug that opens and closes to let air and fuel in and out.
D. The taking in of fuel and air into the cylinder
E. Getting rid of the burned air and fuel mixture
F. A small explosion that makes the engine or car go.

4-STROKE CYCLE ENGINE

ANSWERS

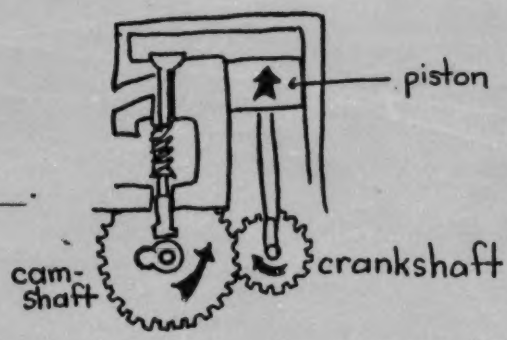
1. C
2. 1. C
   2. D
   3. A
   4. F
   5. E
   6. B

NAME_____ DATE_____

4-STROKE CYCLE ENGINE

1. The four-cycle engine uses_____.

   a. two valves
   b. one valve
   c. transfer ports
   d. rotary valve



2. The camshaft rotates once every _____.

   a. two crankshaft revolutions
   b. crankshaft turn
   c. 1/2 crankshaft revolution

3. The valve is pushed off its seat by the _____.

   a. crankshaft
   b. valve spring
   c. camshaft lobe

4. The two valves used in the 4-cycle engine are called the _____.

   a. exhaust valve and outlet valve
   b. intake valve and exhaust valve
   c. intake valve and outlet valve

5. The four strokes of the four-cycle engine are_____.

   a. intake, compression, power, exhaust
   b. intake, power, outlet, expansion
   c. intake, expansion, ignition, power

6. Intake is _____.

   a. letting the air and fuel in
   b. after compression stroke
   c. during the power stroke

7. Exhaust means _____.

   a. the burned air and fuel
   b. burned water
   c. unleaded fuel

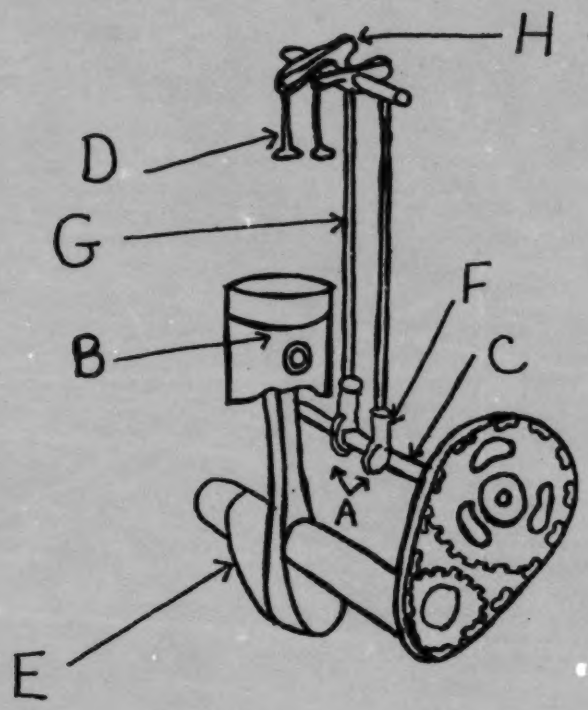
4-STROKE CYCLE ENGINE

ANSWERS

1. A
2. A
3. C
4. B
5. A
6. A
7. A

Label all parts using these words:

rocker arm	crankshaft
valve	cams
push rod	camshaft
piston	valve lifter



A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

Engine

Answers
A. cams
B. piston
C. camshaft
D. valve
E. crankshaft
F. valve lifter
G. push rod
H. rocker arm

CAMS

One camshaft can open both intake and exhaust valves. However each valve is opened by a separate cam.

1. How many cams would there be on a camshaft for a 4 cylinder engine?

2. How many cams would there be on a camshaft for a 6 cylinder engine?

3. How many cams would there be on a camshaft for an 8 cylinder engine?

CAMS

ANSWERS

1. 8
2. 12
3. 16

CLOZE

This engine has two openings at the top of the cylinder. These openings are plugged, _____of the time, with _____ plugs called valves. The _____open and shut. One _____ the valves, the intake_____opens to let in _____air fuel mixture to _____cylinder. The other valve, the exhaust valve opens to let the burned gasses out of the cylinder.

ANSWERS

CLOZE

some

metal

valves

of

valve

the

the

GAS VS. DIESEL

Study the gasoline and diesel engines in this picture. Answer the following questions:

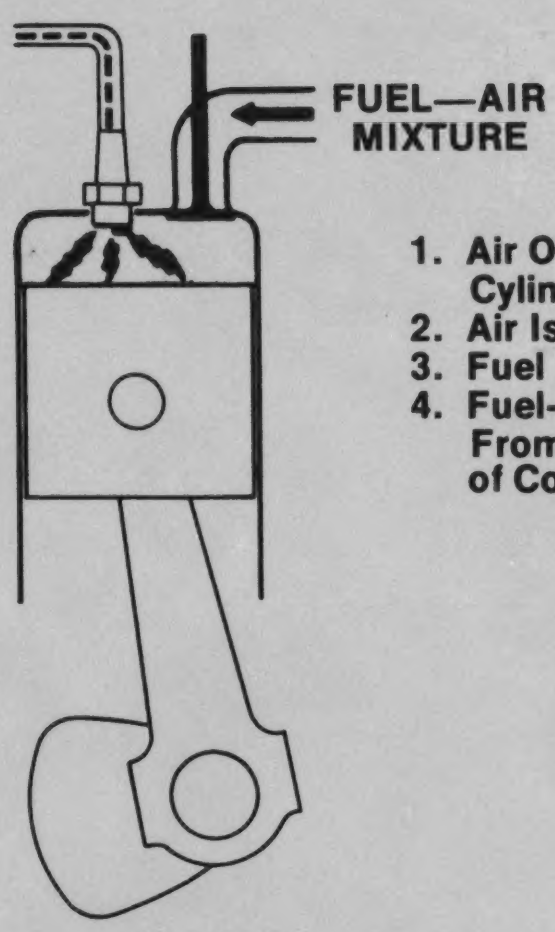
A. Gasoline Engine

B. Diesel Engine

C. Both Gasoline and Diesel Engine

1. A spark plug ignites the gas and air mixture._____
2. Air only is compressed by the piston._____
3. Fuel is sprayed in the cylinder by an injector._____
4. Air and gas mixture is compressed by the piston._____
5. A piston is used during the compression stroke to exert pressure in the cylinder._____
6. Heat from pressure of compressed air and gas causes ignition._____
7. The air and fuel mixture is ignited in the cylinder._____

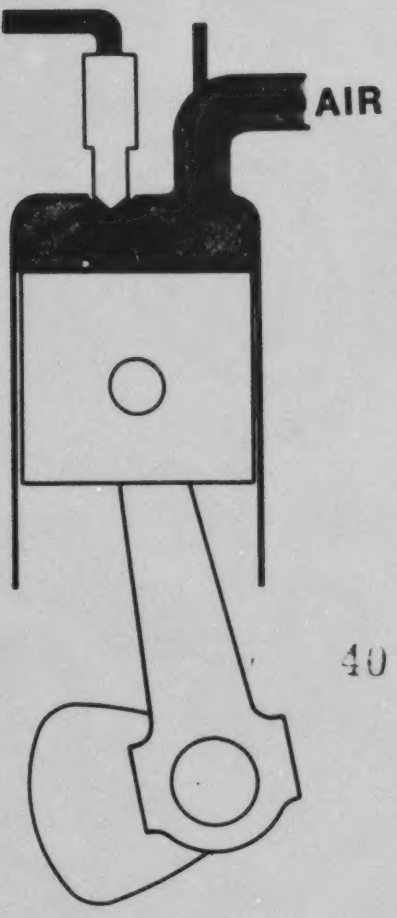
FUEL IGNITION: GAS VS. DIESEL



1. Fuel—Air Mixed in Carburetor
2. Mixture Enters Cylinder and Is Compressed
3. Spark Ignites Mixture

39

GASOLINE



1. Air Only Enters Cylinder
2. Air Is Compressed
3. Fuel Is Sprayed In
4. Fuel-Air Ignites From Heat of Compression

40

DIESEL

GAS VS. DIESEL

ANSWERS

1. A
2. B
3. B
4. A
5. C
6. B
7. B

4-STROKE CYCLE ENGINE

Number these sentences in the order that they would happen in your car.

_____ The piston forces the fuel and air mixture into a smaller space. This is called the compression stroke.

_____ The fuel and air mixture are brought into the cylinder. This is called the intake stroke.

_____ The fuel and air are ignited. This produces the power necessary to drive the car.

_____ The burned fuel and air mixture leave the cylinder. This is called the exhaust stroke.

Unscramble the words below to find the real words. Write each correct word in the space near the scrambled word.

1. clnredyi _____
2. vvale _____
3. tinkea _____
4. pressicomon _____
5. aehstux _____
6. rewop _____
7. sitpon _____
8. nneegi _____
9. leuf _____
10. parks glup (two words) _____

4-STROKE CYCLE ENGINE

ANSWERS

2
1
3
4

1. cylinder
2. valve
3. intake
4. compression
5. exhaust
6. power
7. piston
8. engine
9. fuel
10. spark plug

4-STROKE CYCLE ENGINE

Match where each valve position will be on each of the four strokes.

1. Intake_____
2. Compression_____
3. Power_____
4. Exhaust_____

a. exhaust valve open, intake valve closed
b. intake valve open, exhaust valve closed
c. both intake and exhaust valves are open
d. both intake and exhaust valves are closed

When does it happen?

5. _____The explosion pushes the piston down which creates power.

6. _____Forces the air and fuel mixture into a smaller space.

7. _____The fuel and air mixture are pulled into the cylinder.

8. _____After the fuel and air have been burned, they are pushed out of the cylinder.

9. _____The intake valve is open and the exhaust valve is closed.

10. _____The exhaust valve is open and the intake valve is closed.

11. _____and _____The intake valve is closed and the exhaust valve is closed.

(a Intake Stroke
(b Compression Stroke
(c Power Stroke
(d Exhaust Stroke

ANSWERS

1. B
2. D
3. D
4. A
5. C
6. B
7. A
8. D
9. A
10. D
11. B and C

ENGINE TUTORIAL

W B Y Q T S A A I Q I N G V X
F B A H X E M D Z N O H U S B
C N W Y D C N L E I T C D G J
C R N D D X V O S D L A M Z X
K I A B W N V S I U T E K J X
V A H N D R E A R S B D H E O
N H Z C K R C C L B O I Q K O
H O Y C P S Y O E V U L L T T
U A T M E L H L R N E U P B F
W P O S I X R A Q S G P P X U
E C P N I E H V F K K I B X E
M M D U W P T A T T S J N G D
R E S O D I W E U B L F K E M
R W P I I C W A M S N H P H Z
O U A Q C A Z D X I T I S A L

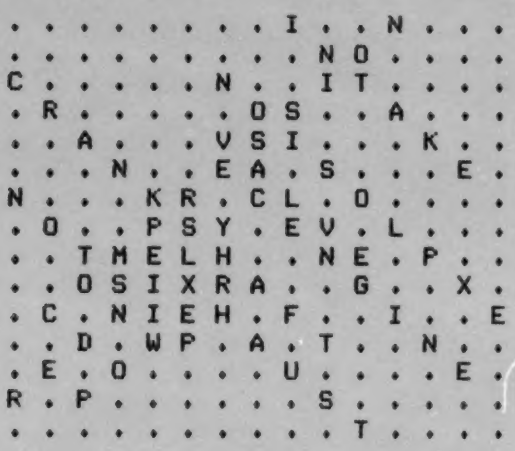
FIND THESE HIDDEN WORDS IN THE PUZZLE

COMPRESSION
CRANKSHAFT
CYLINDER
ENGINE
EXHAUST
EXPLOSION
INTAKE
PISTON
POWER
VALVE

70N

70N

HERE IS THE ANSWER KEY:



FIND THESE HIDDEN WORDS IN THE PUZZLE

COMPRESSION	EXPLOSION
CRANKSHAFT	INTAKE
CYLINDER	PISTON
ENGINE	POWER
EXHAUST	VALVE

NAME_____ DATE_____

BUSHINGS AND BEARINGS

1. Where a gear or a wheel turns on a shaft, or the shaft turns within its support, provision must be made to reduce _____ and wear.

2. When such bushings are kept free of _____ and are properly _____ they reduce friction and absorb most of the wear caused by the rotation of the shaft or wheel.

3. What are the two main types of anti-friction bearings?

   _____ and _____

4. Describe a ball bearing.

5. Describe a roller bearing.

6. Bushings and bearings serve several functions. They serve to reduce _____, provide for _____, and are replaced individually when worn at less expense than replacing a whole machine part.

ANSWER SHEET

BUSHINGS AND BEARINGS

1. friction
2. dirt - lubricated
3. ball - roller
4. Two rings of steel between which is a circle of hard steel balls held in place by a light cage.
5. Two rings of steel between which are little cyliners that roll between, and are held by a light cage.
6. friction - lubrication

GEARS

_____ Has a rim with notched teeth that are nearly the same size as the space between them.

_____ The teeth are usually comparatively small in cross-section, and may be curved.

_____ A double helical, with teeth on the two sides sloping oppositely to each other.

_____ A cylinder with spiral teeth cut in it, and has a coarsely threaded bolt.

_____ Usually has tapered or pointed teeth with rounded hollows between them.

Spur gear

Helical gear

Herringbone gear

Rack or Straight gear

Worm

Sprocket

GEARS

ANSWERS

Spur

Helical

Herringbone

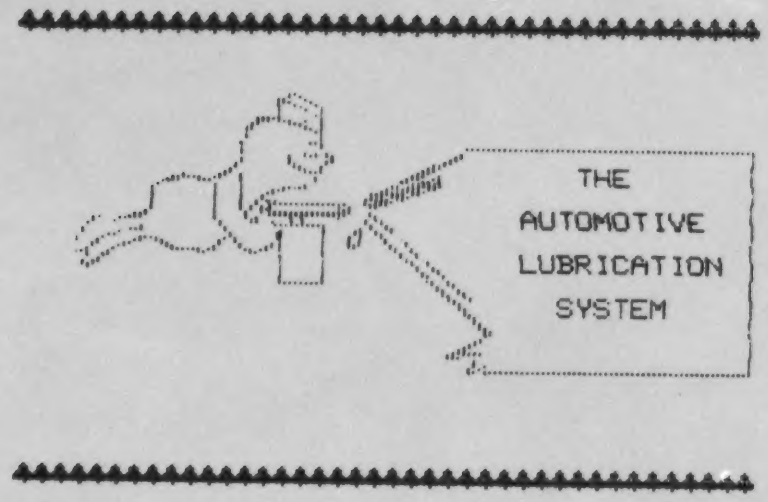
Rack or Straight gear

Worm

Sprocket

Lubrication

PAGE 1
FIGURE 1



PAGE 2

OCCUPATIONAL READING MODULES

OSWEGO COUNTY B.O.C.E.S.

STATE PROJECT #81-3A-9111GS

PROGRAM COORDINATOR:

KATHY FINNERTY

AREA CONSULTANT:

MICHAEL NOTO

PROGRAMMERS:

JIM HURD

CHERYL RITCHIE

PAGE 3

AUTOMOTIVE LUBRICATION SYSTEM

VOCABULARY

LUBRICATION	STATIONARY
SEAL	BEARINGS
PISTON RINGS	SLUDGE
OIL FILTER	OIL DRAIN PLUG
OIL DRAIN PAN	CRANKCASE

****

PAGE 4

THE LUBRICATION SYSTEM IS VITAL TO THE OPERATION OF THE AUTOMOBILE ENGINE. IT PROTECTS THE ENGINE AND KEEPS IT RUNNING SMOOTHLY. IT PROVIDES THE OIL WHICH LUBRICATES, COOLS, SEALS, AND WASHES THE INTERNAL PARTS OF THE ENGINE.

PAGE 5

OIL PERFORMS FIVE MAJOR FUNCTIONS IN THE AUTOMOBILE ENGINE.

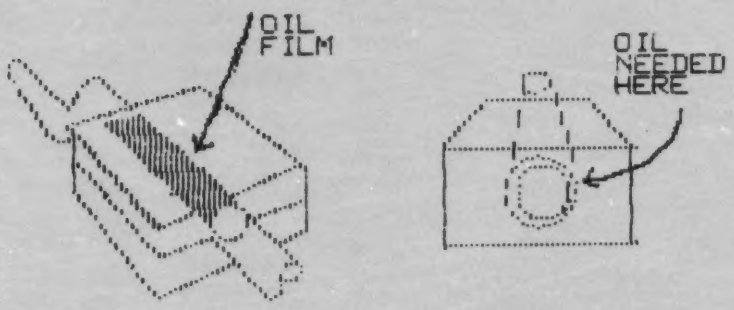
1. OIL MUST LUBRICATE.
2. OIL COOLS ENGINE PARTS.
3. OIL AIDS IN SEALING THE PISTON RINGS.
4. OIL PROTECTS AGAINST ACID AND MOISTURE.
5. OIL MUST KEEP ENGINE PARTS CLEAN.

****

PAGE 6
FIGURE 2

PAGE 7
FIGURE 3

The lubrication system in a car must put a paper-thin layer of oil between moving and stationary parts.

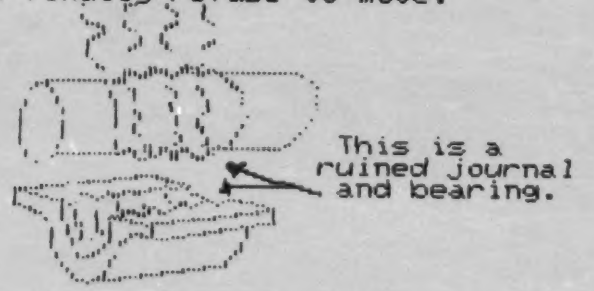


Without this film of oil to support and separate these parts there would be much friction, causing heat and rapid wear.

****

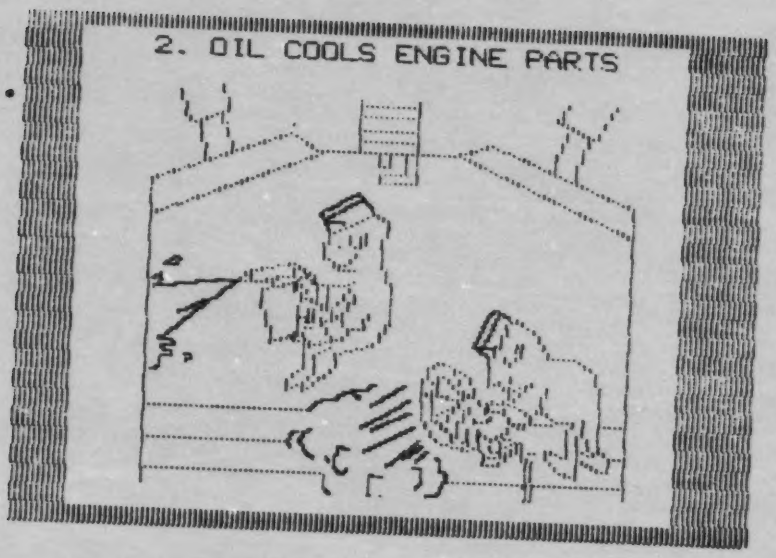
PAGE 8
FIGURE 4

Lack of lubrication can cause two parts in moving contact to overheat, expand, tear bits of metal from each other, stick and finally refuse to move.



OIL COULD HAVE PREVENTED THIS DAMAGE.
=== ===== ==== ========= ==== ======

PAGE 9
FIGURE 5



****

PAGE 10

OIL AIDS IN COOLING THE ENGINE PARTS. FUEL BURNS IN THE CYLINDER AT AN EXTREMELY HIGH TEMPERATURE. AFTER A FEW MINUTES OF OPERATION WITHOUT COOLING THE ENGINE WOULD BECOME RED HOT. CONTINUED HIGH TEMPERATURE OPERATION WOULD QUICKLY DESTROY THE ENGINE.

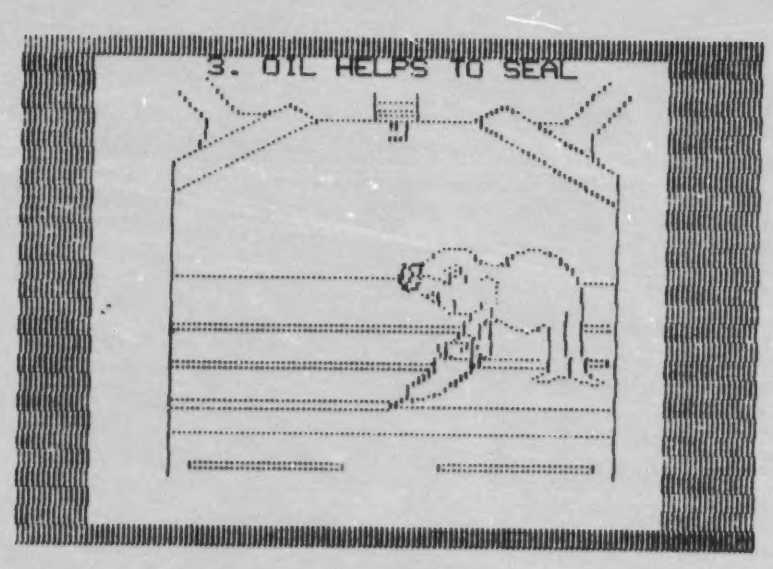
PAGE 11

FRICTION CAN BE REDUCED BY LUBRICATING WITH OIL. AS THE OIL PASSES OVER MOVING PARTS. IT ABSORBS HEAT FROM THEM.

A STEADY FLOW OF OIL THROUGH THE BEARINGS CARRIES AWAY A GREAT DEAL OF THE HEAT THAT IS GENERATED DURING ENGINE OPERATION.

****

PAGE 12
FIGURE 6



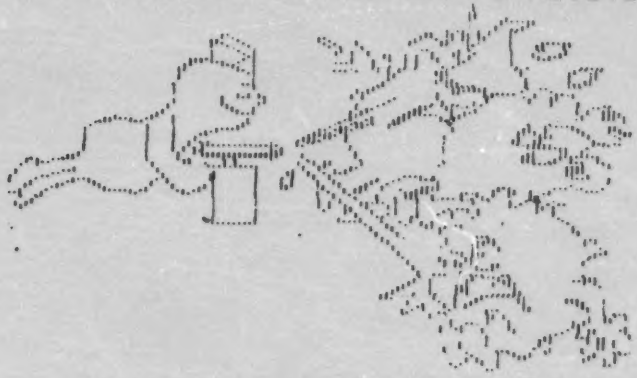
PAGE 13

OIL HELPS SEAL. PISTON RINGS WOULD NOT BE TOO EFFECTIVE WITHOUT OIL AS A FINAL SEALER. IT ALSO ASSISTS IN SEALING AROUND VALVE STEMS.

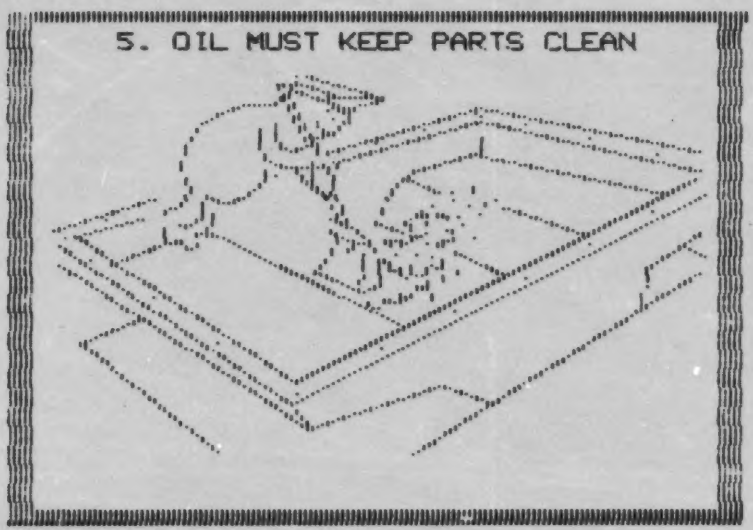
****

PAGE 14
FIGURE 7

4. OIL PROTECTS AGAINST ACID & MOISTURE



PAGE 15
FIGURE 8



****

PAGE 16

A GOOD OIL WILL CLEAN. THE DETERGENTS IN THE OIL ASSIST IN REMOVING SLUDGE, AND CARBON.

A CONSTANT FLOW OF OIL OVER MOVING PARTS WILL ALSO CARRY AWAY METAL PARTICLES THAT ARE WORN OR HAVE BROKEN OFF.

PAGE 17

THE OIL FILTER IS AN IMPORTANT AND NECESSARY PART OF THE LUBRICATION SYSTEM.

THE PURPOSE OF AN OIL FILTER IS TO SCREEN OUT DUST, DIRT, SAND, METAL PARTICLES RESULTING FROM WEAR, AND CARBON PARTICLES FORMED BY COM-BUSTION. A PROPERLY FUNCTIONING FILTER HELPS LENGTHEN ENGINE LIFE BY PROVIDING A CLEANER LUBRICANT

****

PAGE 18

FOR THE ENGINE.

AN OIL FILTER REMOVES DIRT BEFORE THE OIL IS RECIRCULATED. THE OIL MUST FLOW THROUGH THE OIL FILTER. THE OIL FILTER IS A TOUGH, POROUS PAPER THAT TRAPS FINE PARTICLES BUT LETS OIL PASS THROUGH.

PAGE 19

ALL FILTERS EVENTUALLY CLOG UP AND MUST BE REPLACED. REPLACEMENT VARIES BUT WILL AVERAGE EVERY 4,000 TO 6,000 MILES PER FILTER. IN CASE THE OIL FILTER SHOULD PLUG THERE IS A BYPASS SYSTEM THAT ALLOWS THE OIL TO GO AROUND THE FILTER AND CONTINUE TO LUBRICATE THE SYSTEM.

****

PAGE 20

8ON
PAGE 1

OIL NEEDS CLEANING

ENGINE OIL SOON BECOMES CONTAMINATED WITH DUST, BITS OF CARBON, METAL DUST, AND SLUDGE. IF THESE IMPURTIES ARE ALLOWED TO REMAIN IN THE OIL, IT WILL HASTEN ENGINE WEAR. THE AUTOMOBILE IS EQUIPPED WITH AN OIL FILTERING SYSTEM TO REMOVE THESE HARMFUL IMPURITIES.

****

PAGE 2

STUDY CAREFULLY THE STEPS INVOLVED IN CHANGING THE ENGINE OIL AND THE OIL FILTER.

HOW TO CHANGE THE OIL AND FILTER

1. SAFELY RAISE THE VEHICLE ON THE HOIST.

2. GET AN OIL DRAIN PAN AND POSITION IT UNDER THE DRAIN PLUG.

PAGE 3

3. REMOVE THE OIL DRAIN PLUG.

REMEMBER: USE THE PROPER TOOLS
========
WHEN REMOVING THE
OIL DRAIN PLUG.

AND
===

BE VERY CAREFUL !!!
THE TEMPERATURE OF
THE OIL WILL BE
VERY HOT.

****

PAGE 4

4. ALLOW THE OIL TO DRAIN UNTIL THE CRANKCASE IS EMPTY. CLEAN & REINSTALL THE OIL DRAIN PLUG.

5. REMOVE THE OIL FILTER USING AN OIL FILTER WRENCH.

6. GET THE PROPER OIL FILTER. CLEAN GASKET AND SURROUNDING AREA. LIGHTLY OIL NEW GASKET ON FILTER AND TIGHTEN TO RECOMMENDED PROCEDURES.

PAGE 5

7. LOWER THE VEHICLE.

8. RAISE THE CAR HOOD AND LOCATE THE CRANKCASE OIL FILLER TUBE.

9. OBTAIN THE CORRECT AMOUNT, TYPE, AND WEIGHT OF OIL. CONSULT THE MANUFACTURER'S SPECIFICATIONS.

10. FILL THE CRANKCASE TO SPECIFICATIONS. REINSTALL THE FILLER

****

PAGE 6

CAP.

11. START THE ENGINE. CHECK FOR LEAKS AROUND THE OIL FILTER AND DRAIN PLUG.

Designed for use with *Auto Mechanics Fundamentals*, 1978 The Goodheart - Willcox Co., Inc.

Worksheet for pages 94-96 - LUBRICATION

NAME_____ DATE_____

1. Give 2 examples of multi-viscosity oils. _____

2. Which oil would you use in the winter?

   a. 10w-30 b. 20w-50 c. straight 40w

3. Which would run thinner in the summer?

   a. 10w-40 b.20w-50 c. straight 40w

4. How many miles should you change the oil? _____

5. Under what condition should you change the oil more often? (There is more than 1 answer)

   a. If you drive on a highway to work everyday.
   b. You are a farmer driving dusty roads everday.
   c. New York City taxi driver.
   d. The oil filter is poor.
   e. Housewife who drives an average of 10 miles everyday.
   f. Large tractor that plows the dusty fields everyday.

6. Why should a car be allowed to warm up for a few minutes when started instead of stepping on the gas and going immediately? _____

   _____

7. How does the pressure system draw oil from the pan sump?

   _____

8. This part forces oil through what other parts of the engine?

   _____

9. What major part supplies oil to the engine in the splash system?

   _____

10. What type of engine usually uses a splash system?

    _____

ANSWER SHEET

Worksheet for pages 94-96 - LUBRICATION

1. 10w-49 20w-50
2. a. 10w-30
3. a. 10w-40
4. 3000 - 5000
5. b. You are a farmer driving dusty roads everyday
   c. New York City taxi driver
   d. The oil filter is poor
   f. Large tractor that plows the dusty fields everyday
6. warmup engine - oil has a chance to circulate
7. oil pump
8. through special passages to crankshaft and camshaft joints.
9. dippers
10. small one cylinder engines.

Designed for use with *Auto Mechanics Fundamentals*, 1978 The Goodheart - Willcox Co., Inc.

Worksheet for pages 96-99 - LUBRICATION

NAME_____ DATE_____

1. On a regular engine the oil pump delivers oil to the (circle 2)

   a. camshaft bearings
   b. rocker arms
   c. crankshaft bearings
   d. valves

2. On an overhead engine the oil pump delivers oil to the (circle 2)

   a. camshaft
   b. rocker arms
   c. crankshaft
   d. valves

3. What are the 2 systems for oil to get to the bearings?

   _____

4. What is the sump? _____

5. What is placed in the bottom of the sump so the oil does not leak out? _____

6. What is the floating oil pick-up? _____

   _____

7. What are 4 principal types of oil pumps? _____

   _____

8. Which 2 are most commonly used? _____

9. Describe these 2 and how they work? _____

   _____

   _____

   _____

   _____

   _____

ANSWER SHEET

Worksheet for pages 96-99 - LUBRICATION

1. a.camshaft bearings
   c. crankshaft bearings

2. b. rocker arms
   d. valves

3. splash and fuel pressure system

4. part of oil oan which forms reservoir

5. drain plug

6. Floats on top of oil so only take top of oil

7. Gear, rotary, vane, plunger

8. rotary, gear

9. gear - uses gear as moving force to pump oil. Oil gets trapped between gear teeth and then gets pushed through.

   rotary - there is an inner and outer rotar which fits into each other. The inlet pipe picksup the oil and squeezes it around and then lets out outlet.

Designed for use with *Auto Mechanics Fundamentals*, 1978 The Goodheart - Willcox Co., Inc.

Worksheet for pages 103-109 - LUBRICATION

NAME_____ DATE_____

1. What cleans the oil? _____
2. What are the 2 types of filters in general use today?

   _____
3. When should filters be replaced? _____
4. If the filter gets clogged in a full flow filter system, what makes sure the bearings get enough oil? _____

   _____
5. What is the difference between the bypass filter and full flow filter? _____

   _____
6. What are the uses of oil seals? _____

   _____
7. What is used to indicate a low oil pressure or low oil level to the driver? _____
8. Name 3 conditions under which the oil should be checked?

   _____

   _____
9. What stops hydrocarbons from being emitted into the atmosphere?

   _____

   Why is this important? _____
10. What is the PVC? _____
11. What does the air injection system increase? _____

ANSWER SHEET

Worksheet for pages 103-109 - LUBRICATION

1. oil filter
2. by pass and free flow
3. when you change the oil - 3,000 to 5,000 miles
4. small relief valve opens and closes
5. full flow - filters oil before it gets to bearings

   by pass - filters all the time
6. retains oil -prevents leaks
7. oil pressure gauge
8. 1. blue smoke out rear

   2. gauge indicates

   3. hot day
9. emission control devices

   to prevent air pollution
10. pollution device
11. combustion

Designed for use with *Auto Mechanics Fundamentals*, 1978 The Goodheart - Willcox Co., Inc.

Worksheet for pages 109-118 - LUBRICATION

NAME_____ DATE_____

1. What does an antibackfire valve do? _____

2. What are 2 engine modifications that have helped engine emisssions? _____

_____

3. What are 2 carburetor modifications that have increased engine efficiency? _____

_____

4. A lot of cars are equipped with EGR lights. What does it mean?

_____

5. What is "dieseling"? _____

_____

6. What are 3 causes of it? _____

_____

7. Newer cars are equipped with all sorts of emission control devices. Is it against the law to tamper with them? _____

8. Why do we have controls on emissions? _____

_____

9. The oil pressure gauge tells you what? _____

_____

10. When a mechanic says the fuel/air mixture is too lean; Does that mean there is too much gas or air? _____

ANSWER SHEET

Worksheet for pages 109-118 - LUBRICATION

1. controls backfire
2. compression ratio higher so burn unleaded

   increased valve overlap
3. idle screws have limiters

   choke modified
4. pollution devices
5. when car keeps running when key is off
6. high operating temperatures

   fast idle speeds

   too lean mixtures
7. yes
8. for cleaner air
9. how much oil pressure there is
10. air

NAME _____ DATE _____

LUBRICATION SYSTEM REVIEW

1. What does friction mean? _____

_____

2. Why is it harmful to the engine? _____

_____

3. What is the main thing that you put in the engine to reduce friction? _____

4. Oil is classified. Answer the following questions about oil.

A. Which oil would you sue in the summer?

a. SAE 30 b. 10w40 c. 20w50

B. Which oil would you sue in the winter?

a. SAE 30 b. 10w40 c. 20w50

C. What does viscosity refer to? _____

D. What are 3 jobs the oil performs? _____

_____

E. Why is it important to choose oil at the correct viscosity?

_____

F. When should oil be changed? _____

5. What are 2 methods that oil can get to bearings?

_____

6. What is the sump? _____

7. There are 4 types of pumps: gear, rotary, vane and plunger. Which 2 are most commonly used? _____

8. Why is the pressure relief valve important in a car's engine?

_____

LUBRICATION SYSTEM REVIEW

9. What is the importance of oil filters? _____

_____

10. When should they be changed?_____

11. What are emission controls?_____

12. Why are they important?_____

13. What are 2 possible things the oil light being on would indicate?

_____

14. What does the PCV tell us? _____

15. What does the EGR tell us? _____

16. Is it illegal to tamper with emission control devices on cars?

_____

17. What is "dieseling"? _____

18. If your car diesels what are 2 things you might check?

_____

19. How does oil reduce friction? _____

20. What is the difference between a detergent and non-detergent oil?

_____

21. What happens in the full flow system when the filter becomes clogged?

_____

22. How do you check how much oil there is in the sump?

_____

ANSWER SHEET

LUBRICATION SYSTEM REVIEW

1. rubbing two metals together

2. causes heat and wear

3. oil

4. A) c. 20w 50
   B) b. 10w 40
   C) weight of the oil
   D) cleans, lubricates, seals, cools
   E) it can cause excess damage
   F) 2,000 to 5,000 miles

5. splash system
   full pressure system

6. sits on bottom of oil pan, oil goes into it.

7. gear and rotary

8. lets oil go by when oil filter is clogged so it can continue to lubricate.

9. clean oil

10. when you change the oil

11. pollution devices

12. doesn't pollute air

13. low oil level and oil seader

14. pollution device

15. pollution device

16. yes

17. keeps running after car is shut off.

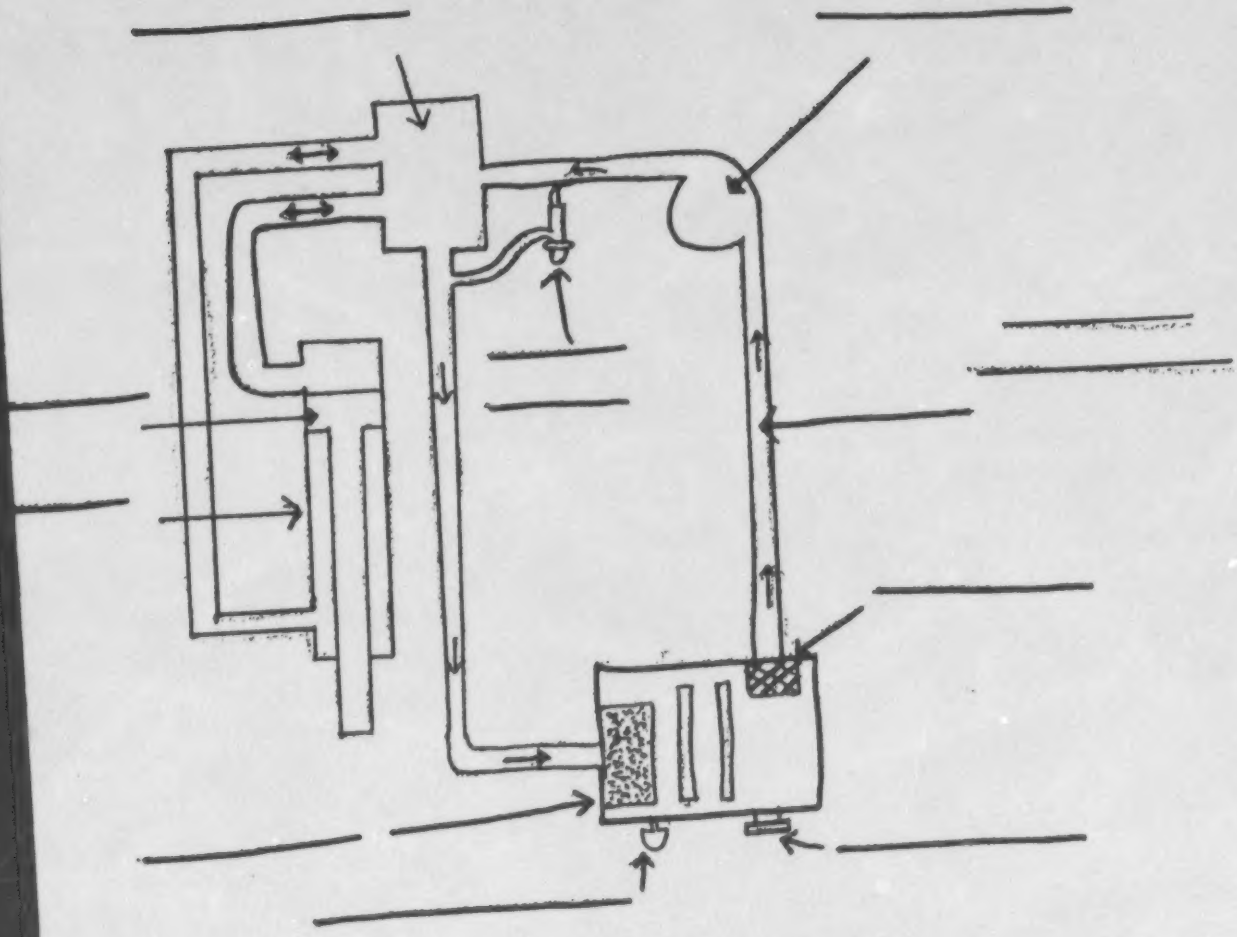
18. high operating temperature, idle, timing, gas/air mixture

19. lubricates parts

20. detergent - prevent sludge in some non-detergent might be too severe

21. oil will be allowed to go by to continue lubrication

22. dipstick



HYDRAULIC SYSTEM

1. _____ _____ for flowing systems is a petroleum base oil, similar to but not identical with lubricating oil for engines.

2. _____ is measured in the same way as motor oil, with 5W very thin and 40 thick.

3. Oil that is too _____ tends to leak back through pumps and out through seals. If too _____, it consumes extra power and makes operation sluggish.

4. Viscosity index (VI) is a measure of _____

_____

5. If VI is high, changes are slight and the oil is _____.

6. If index is low, uou may raise it by adding _____.

7. The pressure in pump and working parts are _____ as long as fluid line between them is open.

8. Pressure is measured in _____.

9. Movement of fluid causes friction which creates heat which obsorbs _____.

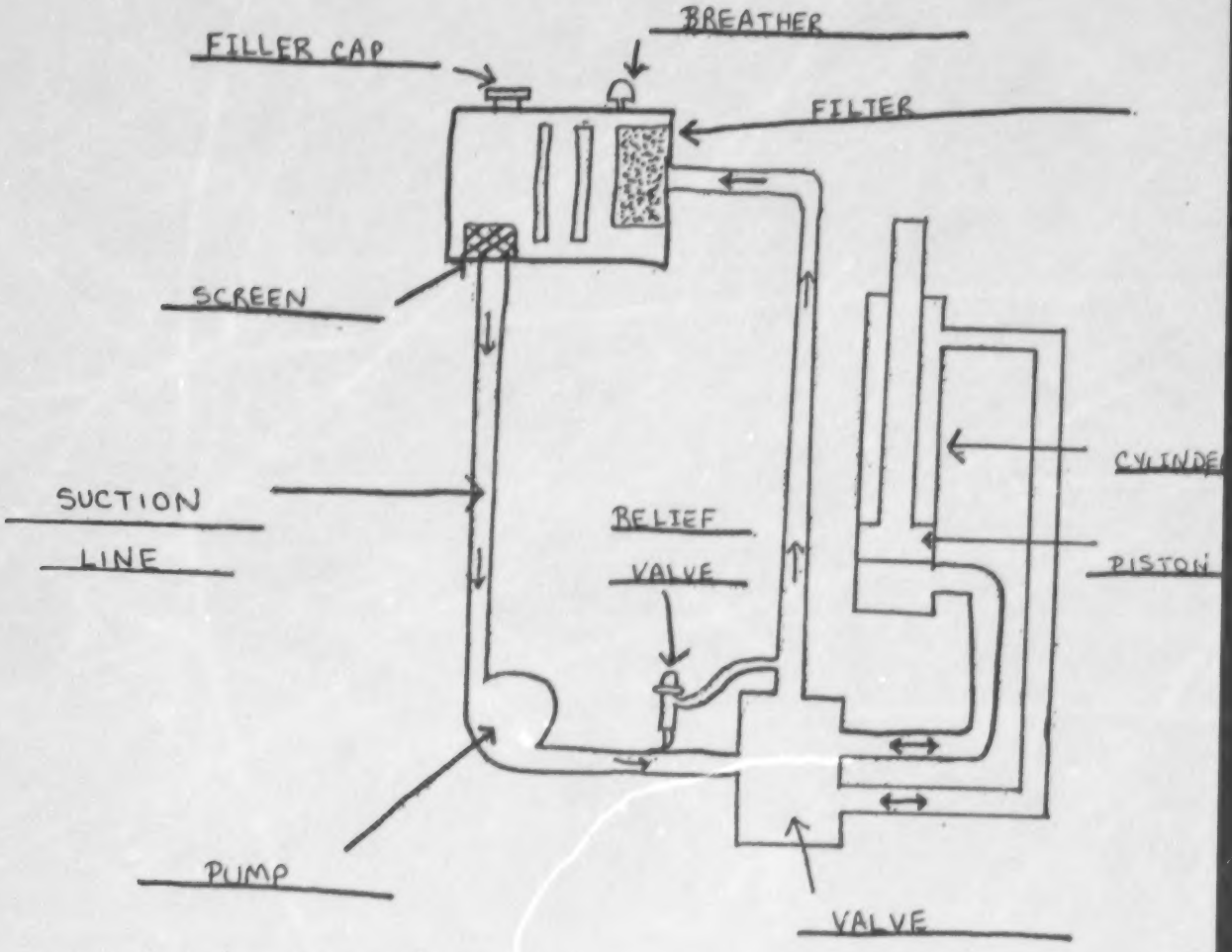
10. This heat requires a _____ _____.

11. "System efficiency may be as low as 70%, but is often between 85 and 95%"

    What is system efficiency?

HYDRAULIC SYSTEM

ANSWERS



1. Hydraulic fluid
2. Viscosity
3. thin, thick
4. A fluid's change in thickness as it heats during work and cools during idle.
5. good
6. viscosity, index improver
7. equal
8. psi
9. power
10. cooling system
11.

Cooling System

NAME_____ DATE_____

COOLING SYSTEMS

1. What are the 2 methods most commonly used to cool an engine?

2. What is the water jacket?

3. What is the path of water in a water cooled engine?

4. How does the water transfer the heat to the outside of the engine?

5. What happens if the water stands still when absorbing the heat?

6. What does the water have to do so that answer number 5 will not happen?

7. What is used to circulate water through the engine?

8. What is the common type of circulating device?

9. What are the 3 functions of the cooling system?

ANSWER SHEET

Worksheet number 1
Cooling Systems

1. air-cooled
   water-cooled

2. An area around the dylinders and valves that is left hollow so that water may circulate for cooling.

3. Water circulates around the engine block, in the water jacket. When the heat of the water reaches a certain temperature the water is allowed to flow through the top hose, through the radiator to the lower hose and back to the water jackets around the cylinder.

4. Heat from combustion - heats H_2O in water jacket (transfers heat to H_2O) - goes to radiator, heat from water is transfered to air - hot air is blown away by the fan.

5. If it does not circulate the H_2O would boil away. It the water stands still, it is of no value for cooling purposes.

6. The water must circulate

7. A water pump.

8. Centrifugal pump using an impeller.

9. The cooling system must remove surplus or unwanted heat.

   It must maintain an efficient temperature under operating conditions.

   It must also bring an engine, when starting, up to operating temperature as soon as possible.

NAME_____ DATE_____

COOLING SYSTEMS

1. What are the three jobs of the cooling system?

   a._____

   b._____

   c._____

2. What is the purpose of the water jacket?

   a. direct coolant flow
   b. control engine temperature
   c. keep engine warm

3. Which part circulates the coolant through the system?

   a. water pump
   b. thermostat
   c. fan
   d. radiator

4. What is the purpose of the fins on the radiator?

   a. direct the coolant
   b. reduce coolant temperature
   c. protect fan from damage

5. What does the pressure cap do?

   a. increase system pressure
   b. decrease system pressure

6. Water will boil at a _____ temperature as altitude increases.

   a. higher
   b. lower

ANSWER SHEET

COOLING SYSTEMS

1. a. reduce heat in engine block
   b. maintain an efficient temperature under operating conditions.
   c. brings the engine up to operating temperature

2. B - control engine temperature

3. A - water pump

4. B - reduce coolant temperature

5. B - decrease system pressure

6. B - lower

NAME_____ DATE_____

COOLING SYSTEMS

1. What is the pump made of?

2. What is used to drive the pump?

3. What happens if the belt is too loose?

4. What happens if the belt is too tight?

5. How do you know how much to adjust the belt?

6. How is the coolant channeled into the engine block?

7. Why do you use this part to channel water?

8. What are water nozzles?

9. Do different engines have different coolant paths?

10. What does the radiator do?

11. If there wasn't a radiator and the water was recirculated, what would happen?

12. What is the purpose of the expansion tank?

ANSWER SHEET

COOLING SYSTEMS

1. The pump housing is cast either of iron or aluminum.

2. A V-belt is used to drive the pump.

3. It will allow the pump and fan to slow down and cause overheating.

4. It will cause premature bearing wear.

5. The belt tension measurement will vary depending upon engine size, design and make, use manual and belt directions.

6. Distribution tubes that assure the even flow of coolant throughout the engine block.

7. The distribution tube is placed in the water jacket. The outlet holes line up with selected areas. This will give certain hard-to-cool areas the type of circulation they need.

8. In addition to distribution tubes, some engines employ water nozzles. Nozzles speed up water circulation around the valve seats.

9. yes

10. Radiator cools the water, the heat of the water is transfered to the air in radiator. The radiator air is blown away by fan.

11. When the coolant leaves the engine, it is quite hot - over 200 degrees. If it were to be immediately pumped back into the engine, it would start to boil and would be ineffective as a coolant.

12. Used to provide additional coolant storage and provides for coolant expansion.

NAME_____ DATE_____

COOLING SYSTEMS

1. Where is the radiator located in most cars?

2. What is the fan used for?

3. Why is it good to have a flow of air on the outside of the engine?

4. What would a thermostat control do for the fan?

5. Why would the blades be arranged unevenly?

6. What connects the radiator to engine and pump?

7. What are the 3 types of hoses used?

8. What is used to secure their fittings?

9. Which hose is a better hose to use if you want to prevent cracking?

ANSWER SHEET

COOLING SYSTEMS

1. The radiator is placed in front of the engine block just behind the grill of the car. The radiator is so placed that it can avail itself of the air that rushes through the grill of the car when it is in motion.

2. To speed up the cooling action of a radiator, a fan is used to draw air through the radiator core.

3. The flow of the air over the outside of an engine will help to remove engine heat.

4. A thermostatic control would allow the fan to slow up when it is not needed.

5. The arrangement lessens the noise

6. rubber hoses, radiator hoses

7. a. common hose
   b. molded or shaped
   c. accordian

8. hose clamps

9. accordian type hose

Designed for use with *Auto Mechanics Fundamentals*, 1978 The Goodheart-Willcox Co., Inc.

Worksheet for pages 80-84 - COOLING SYSTEM

NAME_____ DATE_____

1. What is the job of the thermostat? _____

   _____

2. Are thermostats available in different heat ranges? _____

   Why? _____

3. What happens when the thermostat is closed? _____

   _____ Opened? _____

4. When does water go through the radiator - when the thermostat is closed or opened? _____

5. Why is a pressurized cooling system more effective.? _____

   _____

6. Why shouldn't you take the radiator cap off when the car is hot? _____

7. What are the 2 types of temperature gauges? _____

   _____

   What is the difference between them _____

   _____

8. What are 5 things you should check when winterizing a water cooled system?

   _____

   _____

   _____

   _____

   _____

ANSWER SHEET

Worksheet for pages 80-84 - COOLING SYSTEMS

1. When the engine is cold, the thermostat shuts off the flow of H_2O from the engine to the radiator. As the water is confined to the engine, it heats quickly. When it reaches a predetermined temperature, the thermostat opens and allows free circulation of coolant.

2. Yes, 180° - 195°
   Different temperature ranges depend on the engine needs, load requirements, wheather, etc.

3. Closed - the thermostat is closed the H_2O circulates only around the cylinder block.
   Opened - coolant moves through the thermostat to the radiator.

4. Thermostat is opened

5. The modern, high speed, high horsepower engine produces terrific heat. It has been pressurized, the boiling point of the H_2O is raised. For this reason a pressurized cooling system provides a greater difference between the boiling point of H_2O and the desirable engine operating temperature, the engine tends to produce less exhaust pollutants.

6. A pressurized cap will blow off, throwing hot water. It could cause damage to the person taking off the cap. It can cause supershot steam to escape in a violent fashion.

7. 1) Bourdon Tube Temp. gauge.
   2) Electric Temperature Gauge.

Bourdon Tube Temperature Gauge

Bourdon tubes are made of thin brass. One end is fixed to a gauge fitting and free end is fastened to indicator needle.
When liquid in bulb is heated, it will vaporize and create pressure. This pressure is transmitted to the hollow Bourdon tube through capillary tube.
When Bourdon tube receives pressure, it will spring apart - the free end swings away from fixed end. This movement causes needle to swing across face of gauge.
The bulb is placed in water jacket of engine.
Capillary tubing is strengthened by wire wrapped around it for its entire length.
When water cools, pressure is removed from tube and needle moves back to cold.

Electric Temperature Gauge

Current from battery flows through wire coil that surrounds bi metal (two different metals fastened together) hairpin. It then passes on to the terminal of the sender unit, traveling from the terminal through the spring to the temperature sensitive disc.

As H_2O heats disc, the disc will carry more electricity to ground. Resistance coil on the hairpin will start to heat up. This will transfer heat to hairpin.

Expansion of two dissimilar metals in hairpin causes it to bend as it heats. This bending actuates needle and causes it to move to hot.

When water cools, disc will slow down flow of electricity and hairpin will cool, bending back to its original shape.

Both are effective - will give good service. The electric gauge has one advantage. It can span greater distances from engine to instrument panel by merely adding enough wire to reach.

8. 1. Recommended 1 or 2 yr. drain, flush and refill cycles. Always refill with recommended coolent.
   2. Keep fan and pump belts properly adjusted and check condition.
   3. Keep hoses in good condition.
   4. Watch for irregular operation that might indicate a faulty thermostat.
   5. Keep connections tight.
   6. Keep radiator core clean and dirt free.
   7. Check level of coolant.
   8. Check pressur cap for proper operation.

Designed for use with *Auto Mechanics Fundamentals*, 1978 The Goodheart - Willcox Co., Inc.

Worksheet for pages 85-88, AIR COOLED ENGINES

NAME _____ DATE _____

1. What is the difference between water cooled and air cooled engines?

_____

_____

2. What is the purpose of the fins? _____

_____

3. Is it important for the air to keep circulating? _____

Why? _____

4. What keeps the air circulating? _____

5. What does the thermostat do? _____

_____

6. What types of engines do not need fans? _____

7. What moves the hot air in an air cooled engine? _____

_____

8. What 2 types of units are used to produce a stream of air?

_____

9. What controls the temperature in an air cooled engine? _____

_____

10. Name the principal units in an engine cooling system?

_____

_____

ANSWER SHEET

AIR COOLED ENGINES

Worksheet for pages 85-88

1. Air cooled engines warm up more quickly and operate at higher temperatures than the water cooled engine.

2. fins are added to increase contact surface for air. As heat is generated by the burning fuel mixture, it will be conducted through the walls of the block and be carried away by the air - the greater the surface area the more heat that can be carried away - increase cooling efficiency.

3. yes - The air, if not moved will soon heat up and be unsuitable for further cooling of the finned surfaces.

4. a fan or blower

5. A thermostat allows an accurate measure of engine temperature. When the engine runs cold the thermostat closes the passage. As the engine heats up, air passing to engine will warm the thermostat causing it to expand and open the shutter.

6. motorcycles and aircraft

7. When the engine is started, the block heats quickly. The heat is transferred by conduction to the fins. Air, moved by a fan, passes through a shroud surrounding the fins. Moving air removes the heat from the cooling fins. The amount of air can be controlled by a thermostatic shutter.

8. Air cooled-fan
   metal shrouds
   cooling fins

   H_2O cooled - fan
   radiator

9. thermostat

10. 1. radiator for cooling
    2. water pump for circulation
    3. thermostate for temperature control
    4. pressure cap for pressurization of the entire system
    5. Bypass valve to allow recirculation while heating up
    6. Fan to provide a moving stream of air through the radiator

NAME_____ DATE_____

COOLING SYSTEM REVIEW

Answer the following questions without using a text book.

1. What are the 3 jobs of the cooling system?

_____

_____

_____

2. What is the difference between an air cooled and water cooled engine?

_____

3. What happens if the water in a water cooled engine was to be stagnant (not move)?

_____

4. What will prevent the situation in number 3?

_____

5. What is the purpose of the water pump?

_____

6. What is used to drive the pump?

_____

7. How is it adjusted?

_____

8. What is the function of the distribution tube?

_____

9. What is the purpose of the water nozzle?

_____

10. What part of the cooling system cools the water off?

_____

11. What controls the water flow and temperature?

_____

12. When the engine is cold the thermostat is _____

a. opened
b. closed

13. When the engine is hot the thermostat is _____

a. opened
b. closed

14. What type of hose is most effective when bent to resist cracking?

a. molded or shaped
b. accordian
c. common

15. Water passes through the radiator when the _____

a. engine is cool
b. engine is hot
c. all of the time
d. never

16. Why is a pressurized system effective? _____

_____

17. Why should you never take the radiator cap off when the car is hot?

_____

18. What are the 2 types of temperature gauges, and which is better?

_____

19. Is a thermostat used on an air cooled system? _____

20. Why are the fins important on an air cooled engine?

_____

21. A fan will inflict serious injury if you come in contact with it.

true or false

22. What is meant by the heat range of the thermostat?

_____

23. Name 5 things to check when winterizing a car.

_____

_____

_____

_____

_____

24. How does anti-freeze work in a car?

_____

25. What types of vehicles do not require any collant or anti-freeze?

_____

ANSWER SHEET

COOLING SYSTEM REVIEW

1. Remove surplus and unwanted heat
   maintain an efficient temperature
   It must also bring an engine, when starting, up to eoperating temperature as soon as possible.

2. Air cooled using cooling air blown over heat to draw away heat.
   Water cooled using a H_2O and ethylene-glycol mixture to cool engine heat.

3. If H_2O didn't move the H_2O would boil away, H_2O standing still would have no value for cooling purposes.

4. The addition of a H_2O pump circulates water so it will not become stagnant.

5. to circulate H_2O through the engine

6. V-belt fan belt

7. Various screws and belt tension measurement.

8. Coolant is channeled into an engine block by means of the distribution tube.

9. speed up water circulation around the valve seats

10. radiator

11. thermostat

12. closed

13. opened

14. B

15. B

16. By adding pressurization to the system, it is possible to operate an engine at temp. exceeding 250 without boiling. Also increases water pump efficiency.

17. When the pressure is suddenly removed from the system, it can cause superhot steam to escape in a violent fashion.

18. Bourdon Tube Temperature Gauge
    Electric Temperature Gauge

19. yes

20. they increase the surface area to cool air.

COOLING SYSTEM REVIEW

21. true

22. The temperature at which the thermostat will operate. Common heat ranges are the 180 and 195 thermostats. The 180 thermostat opens near this temperature and is fully opened around 200 The 195 type starts opening near 195 and is fully open around 218 . The exact thermostat temperature range used will depend on the engine, load requirement, weather, etc.

23. 1) 1 or 2 year drain, flush and refill cycle
    2) always refill with recommended coolant
    3) keep fan and pump belt properly adjusted and check condition
    4) check hoses
    5) check thermostat
    6) keep connections tight
    7) keep radiator coreclean and free of dirt
    8) check level of coolant
    9) check pressure cap

24. Anti-freeze is a chemical added to the cooling system to prevent coolant from freezing in cold weather.

25. Air-cooled engines motorcycles and aircraft

NAME_____ DATE_____

COOLING SYSTEMS

VOCABULARY WORKSHEET

transfers	conductors
circulate	expansion
impeller	thermostat
distribution	pressurized

Put the correct word into the sentence.

1. Water absorbs heat from the engine parts. In turn the water _____ some of its heat to the outside of the engine.

2. This tank is used to provide additional coolant storage. _____

3. Cooper and some other metal are _____ of electricity and heat.

4. When the engine is cold the _____ shuts off the flow of water from the engine to the radiator.

5. If the cooling system is _____, the boiling point of water is raised.

6. The coolant may be channeled into an engine block by means of _____ tubes.

7. The _____ consists of a round plate fastened to a rotating shaft to which a series of flat or curbed vanes are attached.

8. In order to have the water function as a cooling agent it must _____ throughout the engine.

Write the eight words above in alphabetical order.

_____

_____

_____

_____

ANSWER SHEET

COOLING SYSTEMS

1. transfers
2. expansion tanks
3. conductors
4. thermostat
5. pressurized
6. distribution
7. impeller
8. circulate

ALPHABETICAL ORDER

circulate

conductors

distribution

expansion tanks

impeller

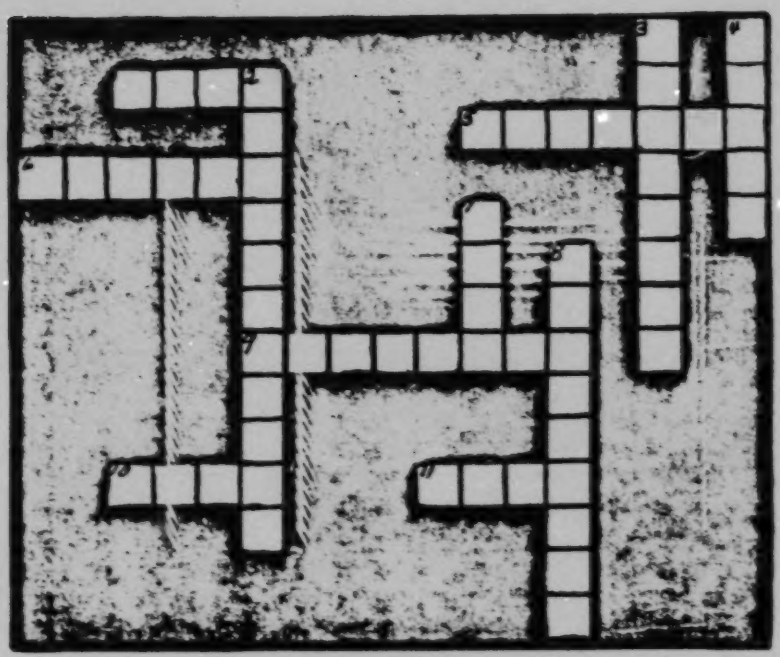
pressurized

thermostat

transfers

NAME_____ DATE_____

COOLING SYSTEM



WORDS TO CHOOSE FROM

pump
engine
circulate
water
fuel
coolant
pressurized
hose
transfer
belt
radiator

ACROSS

1. This circulates water through the engine.
5. We put this into the radiator to stop the car from overheating.
6. This is the muscle in making the car run.
9. Water passes through this area to be cooled.
10. The radiator is connected to the engine and pump by means of a rubber _____.
11. This is put in the tank to keep the car running.

DOWN

2. Air cannot escape because a pressure cap has sealed the opening. The cooling system is _____.
3. Engine parts absorb this heat and then _____ some of it to the outside of the engine.
4. We drink this.
7. The drive _____ runs the fan.
8. If water stands still this does not occur. In order to function as a cooling agent the water must _____.

ANSWER SHEET

ACROSS

1. pump
5. coolant
6. engine
9. radiator
10. hose
11. fuel

DOWN

2. pressurized
3. transfer
4. water
7. belt
8. circulate

COOLING SYSTEMS

1. Without a cooling system the car would have a serious _____ problem.
2. When filling the cooling system, clean, soft _____ should be used. This will help to prevent scale deposits.
3. What are scale deposits?

4. Why are they harmful to the engine?

5. In areas of the country where temperatures drop below freezing it is necessary to add _____ to the cooling system.
6. What three things determine the correct amount to add?
   1.
   2.
   3.
7. The three main types of antifreeze are denatured (ethyl) alcohol, methanol (wood) alcohol and ethylene glycol. Ethylene glycol has many advantages, name some: (called permanent type anti.)
   1.
   2.
   3.
8. A cooling antifreeze can be left in the cooling system all summer. TRUE FALSE
9. Some cars with air conditioning may require the use of anti-freeze during the summer months. TRUE FALSE
10. Ethylene glycol can be mixed with gin to get a really good drink on a Friday night. TRUE FALSE

11. Often a new car is filled with an antifreeze solution that will last for one year. TRUE FALSE

12. In Northern New York it is best to drain antifreeze when winter is over, flush system and fill with fresh water, water pump lubricant and rust inhibitors. When winter comes again flush system and again put proper antifreeze in. TRUE FALSE

13. Fill antifreeze system with car engine on. TRUE FALSE

14. Shake antifreeze in can to insure a proper mixture. YES NO

15. Run the car engine after antifreeze is added, it will help mix antifreeze and gasoline. TRUE FALSE

16. A special hydrometer may be used to check the ratio of antifreeze and water. TRUE FALSE

17. It is O.K. to overfill coolant. TRUE FALSE

COOLING SYSTEMS

ANSWERS

1. overheating
2. water
3. Hard layers of chemicals built up in certain areas of the system, especially in extra hot sections.
4. Reduce transfer of heat to coolant.
5. antifreeze
6. 1. capacity of the cooling system
   2. type of antifreeze
   3. lowest anticipated temp.
7. 1. will not cause fire
   2. does not harm car finishes, (maybe some heat spotting)
   3. does not readily evaporate
8. TRUE
9. TRUE
10. FALSE-Ethylene glycol is poisionous
11. FALSE-two years
12. TRUE
13. FALSE
14. YES
15. FALSE-mix antifreeze and water
16. TRUE
17. FALSE-overflow will result and lose of coolant

FINDING SMALL EXTERNAL LEAKS IN THE COOLING SYSTEM

1. System cleaning may open tiny _____ or other openings that have been sealed with rust.

2. To check for the possibility of leakage following cleaning the system should be _____ tested.

HOW TO PRESSURE A COOLONG SYSTEM

3. Fill _____ to within ½" of the filler neck. Attach a pressurizing _____ to the radiator filler neck.

4. Build up pressure in the system carefully. Do not _____ the pressure for which the system is designed. Check the pressure marking on the radiator cap or obtain information from manufacturer's manual.

5. When the system is pressurized, watch the _____. If the pressure holds _____ the system is probably all right. If the pressure _____, check all areas for leaks.

6. Remove the pressure pump, replace the _____ _____ and run the engine until normal heat is reached. Remove the cap, attach the pressure pump and once again _____ the system. Recheck for leaks. Even dampness indicates enough loss of _____ to cause trouble.

7. When finished with the pressure test, adjust _____ to proper level in the radiator.

FINDING SMALL EXTERNAL LEAKS IN THE COOLONG SYSTEM

ANSWERS

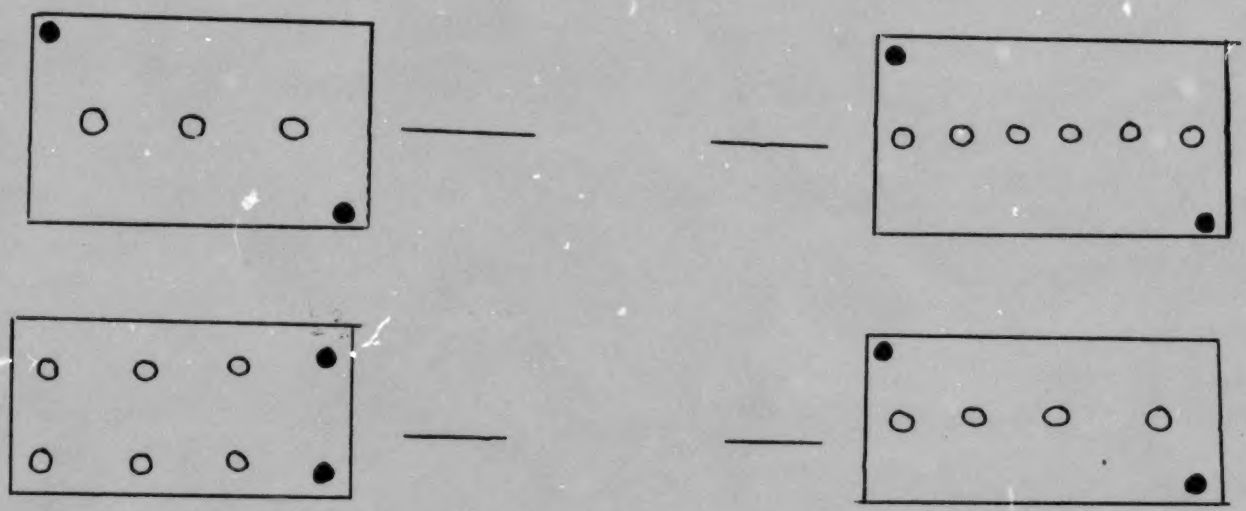
1. cracks
2. pressure
3. radiator, pumps
4. exceed
5. gauge, steady, drops
6. radiator cap, pressurize, coolant
7. water

Ignition Circuit

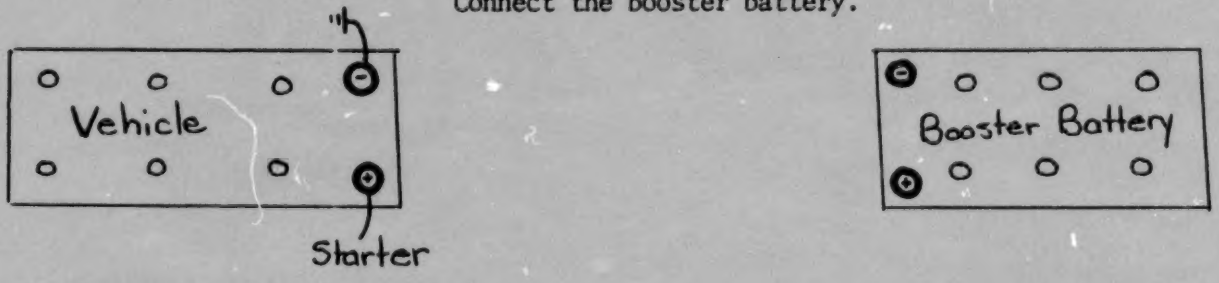
Electrical System

HERO- Heavy Equipment Repair and Operation

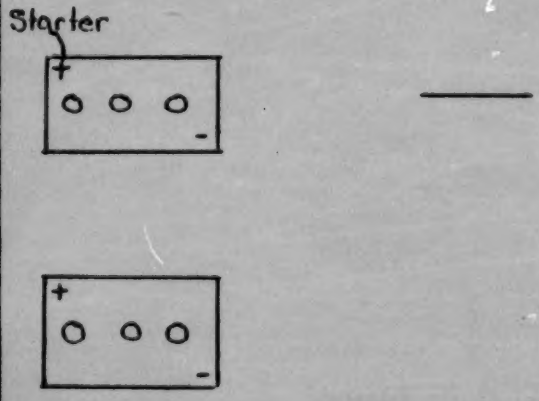
Determine the voltage capacity of each battery.



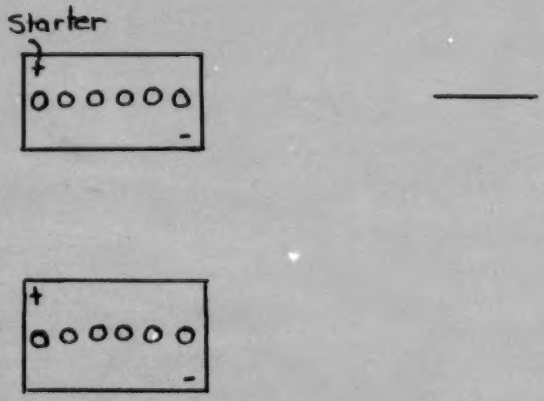
Connect the booster battery.



Connect these batteries in series and write the final voltage output.

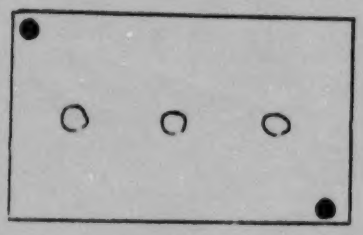


Connect these batteries in parallel and write the final voltage output.



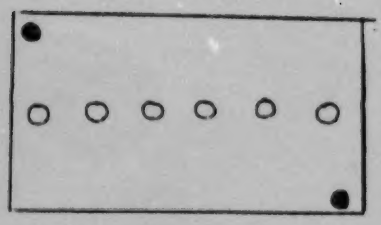
HERO- Heavy Equipment Repair and Operation

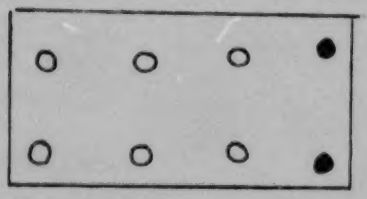
Determine the voltage capacity of each battery.



6

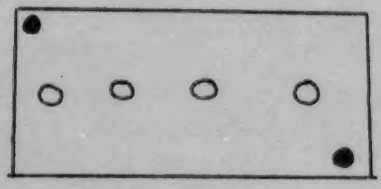
12

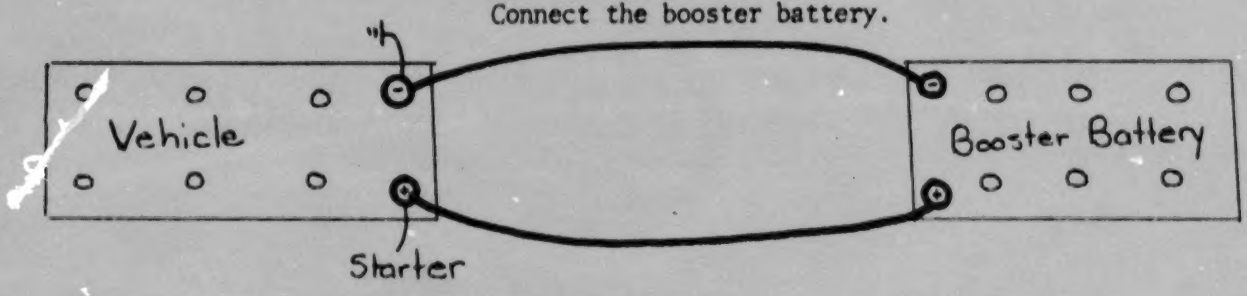




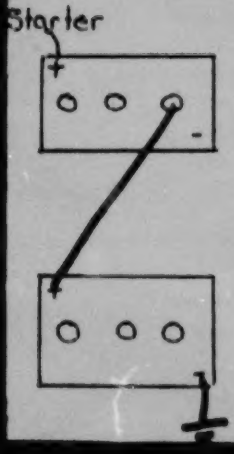
12

8





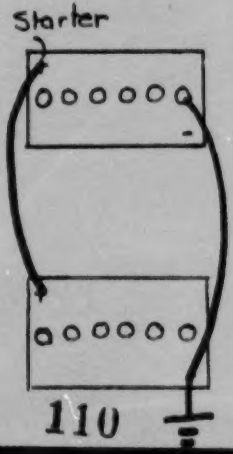
Connect these batteries in series and write the final voltage output.



12

Voltage adds on a series circuit.

Connect these batteries in parallel and write the final voltage output.

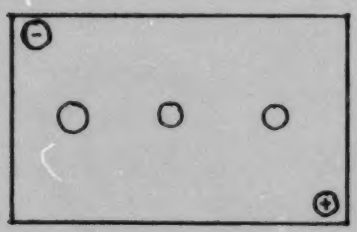


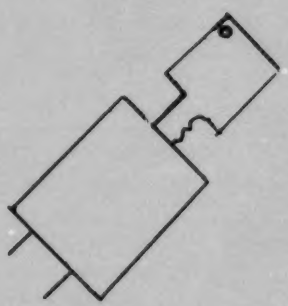
12

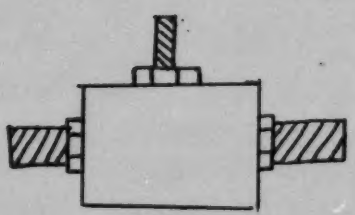
Voltage stays the same on a parallel circuit.

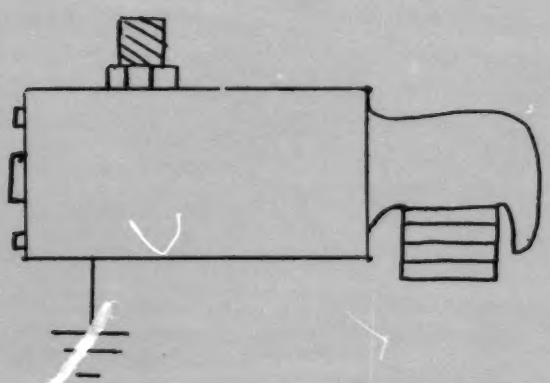
Heavy Equipment Repair and Operation- HERO

Wire the starting circuit below so that it will operate off the key switch. Determine what the voltage capacity of the battery is and wire it as a negative ground.



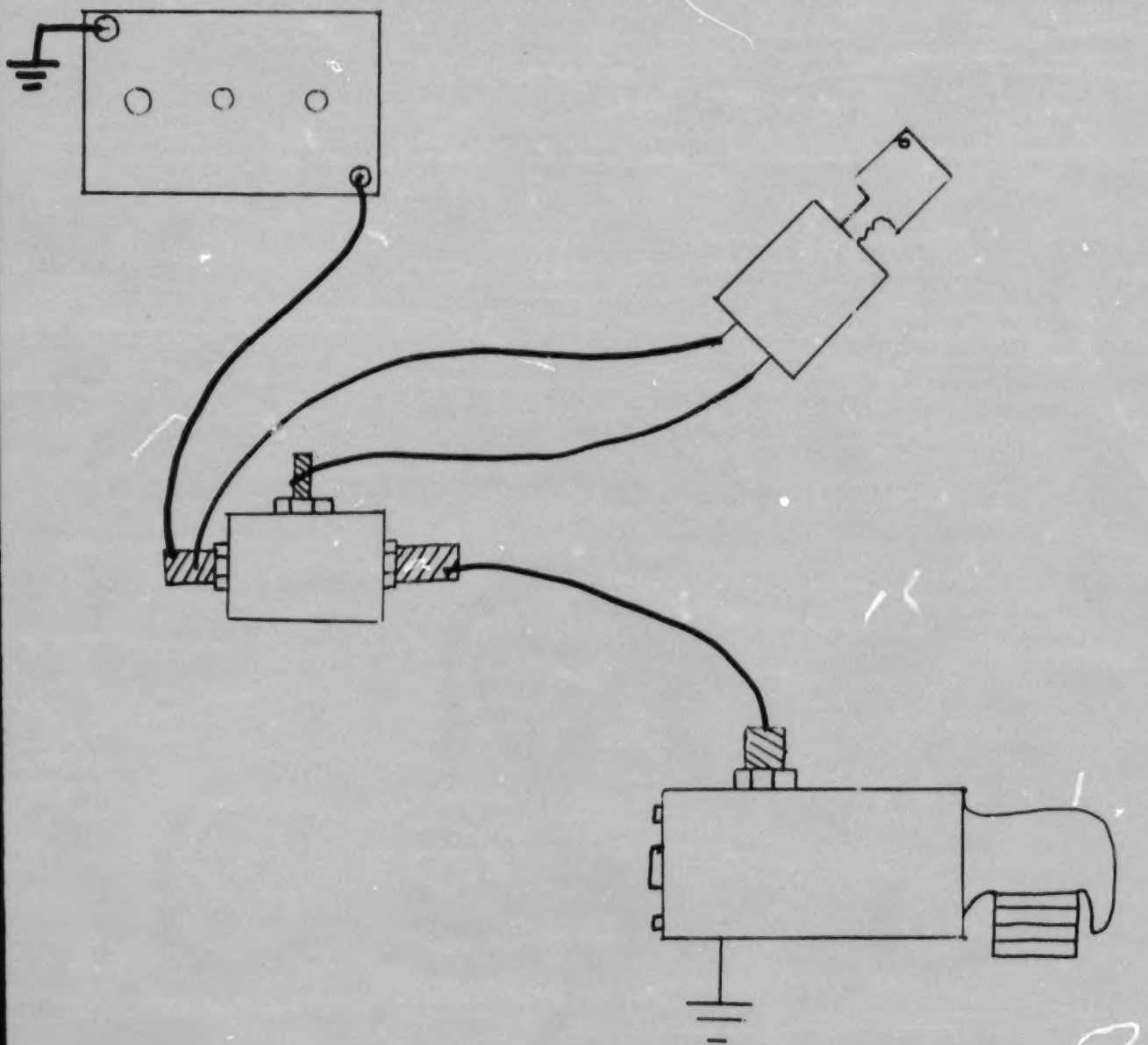




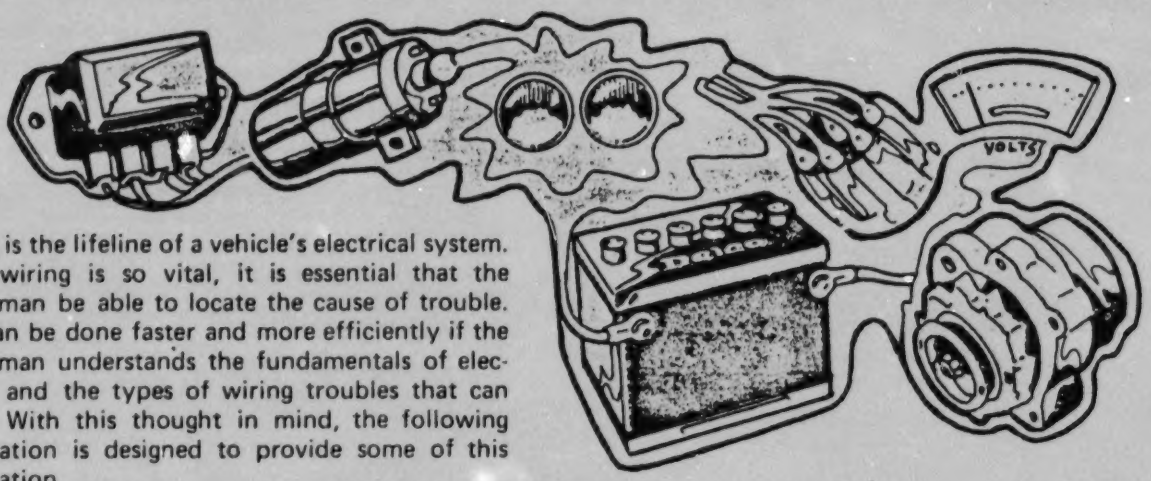


Heavy Equipment Repair and Operation- HERO

Wire the starting circuit below so that it will operate off the key switch. Determine what the voltage capacity of the battery is and wire it as a negative ground.



ELECTRICAL CIRCUITS AND TESTING



Wiring is the lifeline of a vehicle's electrical system. Since wiring is so vital, it is essential that the serviceman be able to locate the cause of trouble. This can be done faster and more efficiently if the serviceman understands the fundamentals of electricity and the types of wiring troubles that can occur. With this thought in mind, the following information is designed to provide some of this information.

ELECTRICAL TERMS

Voltage = Electrical pressure measured in volts. This is the force that causes current to flow in an electrical circuit. The electrical symbol is "E".

Current = Flow of electricity measured in amperes. Current can be compared to the flow of water in a pipe. It simply describes what it is, not how much is flowing. The rate of flow (amount of current) is measured in amperes (abbreviated amps). The electrical symbol is "I".

Resistance = Electrical friction (opposition to current flow) measured in ohms. Everything has resistance but in varying degrees. The resistance in wiring can be compared to the friction in a pipe. Wiring resistance increases as the length increases and decreases as the size increases. The smaller the number of wire size, the larger the wire. For example, No. 6 wire is larger than No. 14 wire and has less resistance per foot. The electrical symbol for resistance is "R". The Greek letter Omega (Ω) is used as an abbreviation for the word "ohm".

Voltage Drop = The loss of voltage caused by a flow of current through a resistance. It increases as current flow or resistance increases. Sometimes called voltage loss or line loss. Can be measured with a voltmeter connected from one point to the other with current flowing in the circuit. The total voltage drop in a circuit is equal to the voltage of the source.

Circuit = A complete path for the flow of electricity. If there is a difference in pressure (voltage) between the ends of the circuit, current will flow. The amount of current that will flow is determined by the voltage applied and the total resistance of the circuit.

Short Circuit = A connection in a circuit that results in lower resistance and usually results in higher than normal current flow.

Grounded Circuit = A connection between a wire and ground (any metal parts of a unit or chassis) and usually results in a higher than normal current flow.

Open Circuit = A break in a wire or connection that prevents any current flow through that wire or connection.

FUNDAMENTALS OF ELECTRICITY

The key to understanding electrical circuits and intelligent troubleshooting is a thorough knowledge of electrical fundamentals. The heart of these fundamentals is Ohms Law, which is the mathematical relation between voltage, current, and resistance.

Ohms Law states briefly that current flowing in a circuit varies directly with the voltage and inversely with the resistance. The pressure of one volt applied to one ohm of resistance will cause one ampere of current to flow. If any two of the three terms (volts, amps, ohms) are known, the missing term can be found by applying Ohms Law. The mathematical formula of Ohms Law is easiest to remember when put in the form of a circle as illustrated below. To use the circle, cover the unknown term and perform the operation indicated (multiplication or division). The mathematical symbols of these three terms are used in the formula to find the unknown term:

Volts = E

Amperes = I

Resistance = R

Examples $E = I \times R$

$I = \frac{E}{R}$

$R = \frac{E}{I}$

BASIC CIRCUITS

There are times when Ohms Law alone is not sufficient to figure out a circuit. In these cases, there are rules for the behavior of voltage, amperage, and resistance in different types of circuits, which can be used to find the missing information but are beyond the scope of this manual so are not covered herein.

Shown below are the definitions of, and rules for, each of these circuits. Circuits are classified as series, parallel, or series parallel. Series parallel is simply a combination of the first two. The circuits illustrated have been worked out to show the distribution of volts, amps, and ohms.

1. Series circuits are those which have only one path in which the current can flow. A break or opening stops the flow of current in the entire circuit. (Figure 1)

Voltage: Is divided among the resistances in direct proportion to their resistance value. (The higher the resistance, the higher the voltage drop across the resistance.) The voltage of the source is equal to the total of the individual voltage drops.

Amperage: Is the same in all parts. There is only one amperage in a series circuit.

Resistance: The total resistance of the circuit is the sum (total) of the individual resistances.

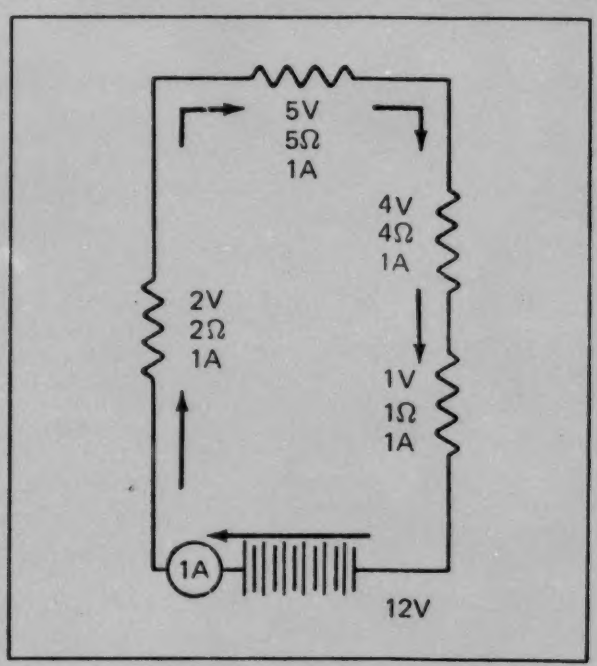


Figure 1 - Series Circuit

2. Parallel circuits are those which have more than one path (or branch) in which the current can flow. In such circuits, one terminal of each device is connected to one common conductor and the remaining terminals to another common conductor. Each device operates independently of the others. (Figure 2)

Voltage: Is the same across all branches.

Amperage: Divides among the branches. (Lowest resistance branch has the most amperage.)

Total amperage is the sum (total) of the amperage in each branch.

Resistance: Decreases as more branches are added.

Total resistance is less than the resistance of any one branch.

Total resistance can be found by one of two formulas:

$$R_t = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}} \text{ etc.}$$

for any number of resistances in parallel.

$$R_t = \frac{R_1 \times R_2}{R_1 + R_2}$$

for two resistances at a time.

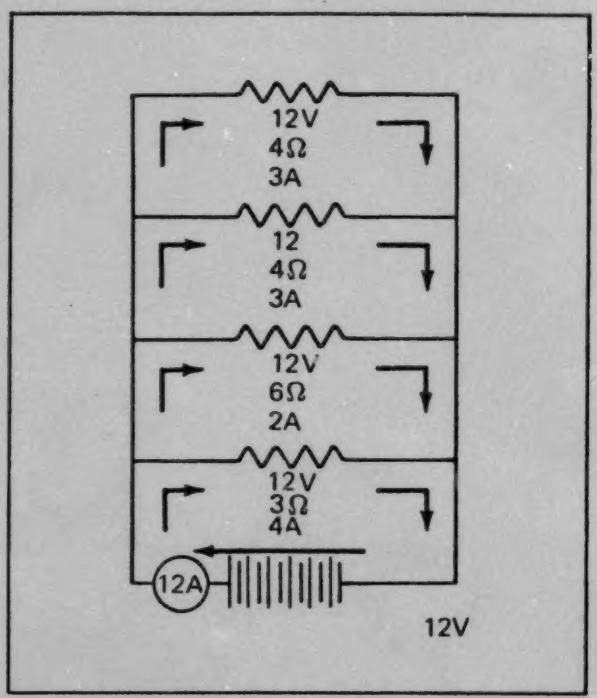


Figure 2 - Parallel Circuit

3. Series parallel circuits are those which have some devices connected in series, with other devices connected in parallel. It is simply a combination of the first two. (Figure 3)

To solve such a circuit, the total resistance (R_t) of each parallel part has to be found first and then added to other resistances that are in series to find the total resistance of the circuit.

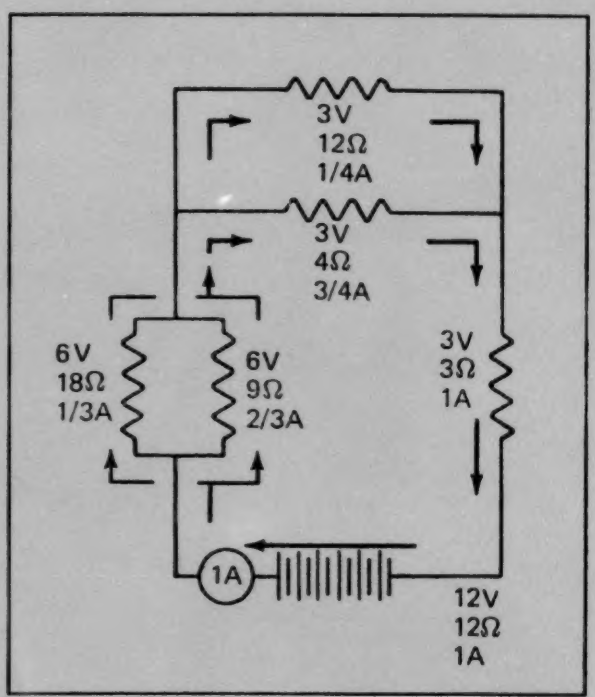
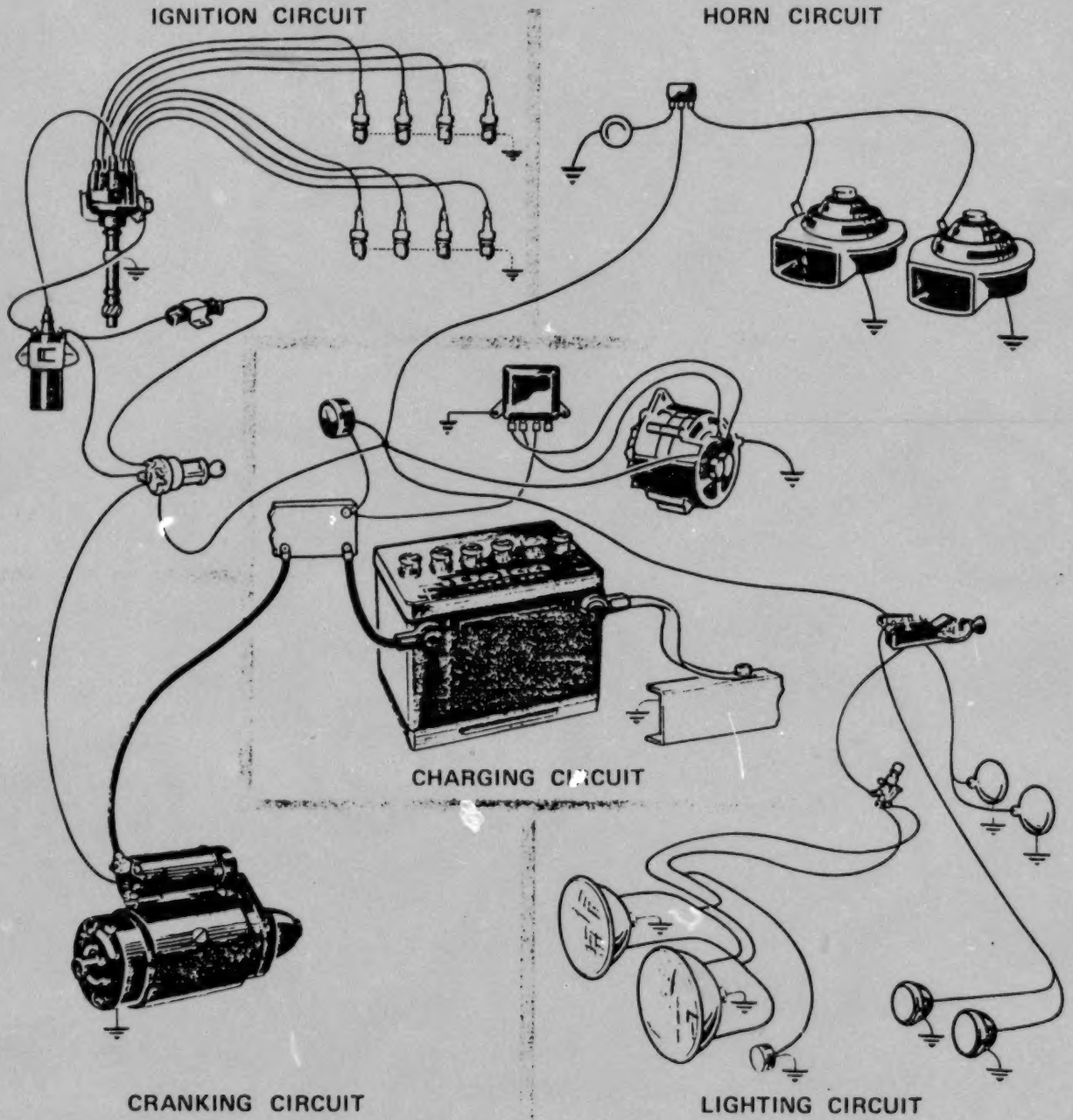


Figure 3 - Series Parallel Circuit

In order to simplify, and aid diagnosis of possible problems in any circuit, it is easiest to divide the electrical system into five basic circuits or systems. These are:

1. Battery Circuit
2. Cranking Circuit
3. Ignition Circuit
4. Charging Circuit
5. Lighting and Accessories

TYPICAL AUTOMOTIVE ELECTRICAL SYSTEM



WIRING COLOR CODES - HERO

1. Place the letter of the circuit that relates to the proper color in a tractor-trailer light cord.

A. Auxilary Circuit	1. Yellow
B. Ground Wire	2. Red
C. Left Directional	3. Green
D. Right Directional	4. White
E. Stop Light Circuit	5. Blue
F. Tail Clearance Marker Light	6. Brown
G. Identification, clearance, and side marker lamps	7. Black

2. Electrical Terms

1. _____ Voltage	A. Flow of electricity measured in amperes.
2. _____ Current	B. The loss of voltage caused by a flow of current through a resistance.
3. _____ Resistance	C. A complete path for the flow of electricity.
4. _____ Circuit	D. Electrical friction measured in ohms.
5. _____ Voltage drop	E. A break in a wire or connection that prevents any current flow through that wire or connection.
	F. Electrical pressure measured in volts.

WIRING COLOR CODES - HERO

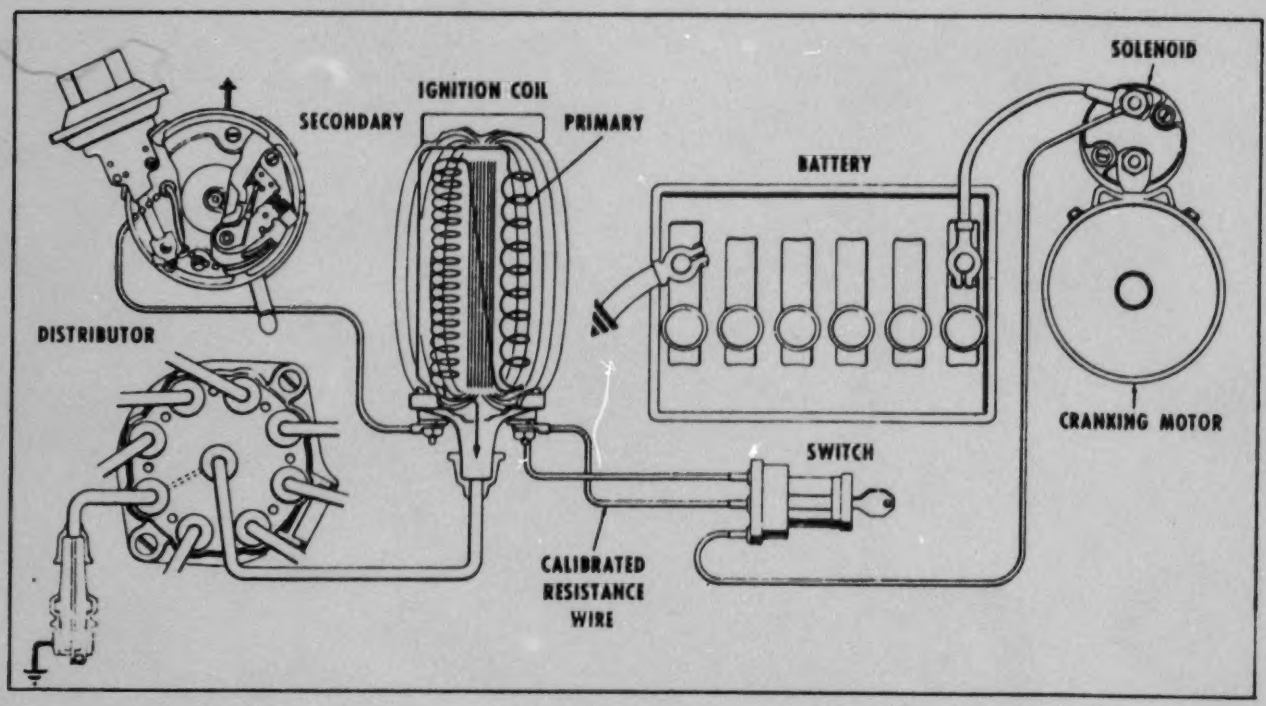
ANSWERS

1. 1. C
   2. E
   3. D
   4. B
   5. A
   6. F
   7. G

2. 1. F
   2. A
   3. D
   4. C
   5. B

Delco
Wire & Cable
Wiring Manual

IGNITION CIRCUIT AND TESTING



Ignition Circuit

___1. The electrical voltage in a 12 volt system is approximately _____ volts when it reaches the spark plug.

A. 20,000 volts
B. 240 volts
C. 12 volts
D. 200,000 volts

___2. In the starting system the device which is an electromagnet that connects the battery to the load is the _____.

A. starter
B. solenoid
C. start/ignition switch
D. regulator

___3. When completing the shop work order it is most important to write the _____, so that the correct parts and service manuals can be used.

A. year
B. wheel base
C. serial number
D. condition

___4. Each cell in a storage battery has a potential of about _____.

A. 2 volts
B. 6 volts
C. 4 volts
D. 2 ohms

___5. The solution of concentrated sulfuric acid and water in a battery is called _____.

A. specific gravity
B. electrolyte
C. voltage
D. liquid solution

___6. Which of the following battery hydrometer reading would indicate a fully charged battery? _____

A. 1.110
B. 1.215
C. 1.260
D. 1.230

___7. When cleaning a battery it is important not to get any cleaning solution in the cells as it will damage the battery. A good cleaning solution to use on the outside of the battery is _____.

A. penetrating oil and H_2O
B. anti-freeze and water
C. baking soda and water
D. safety solvent

HERO

ANSWERS

1. A
2. B
3. C
4. A
5. B
6. C
7. C

IGNITION CIRCUIT

1. The condition of a spark plug may affect the timing.

True False

2. It makes sense to overfill a battery with electrolyte solution. Then when the electrolyte is used up more will be available.

True False

3. The condenser provides a storage area for the current flowing through the ignition circuit.

True False

4. The distributor serves to open and close the primary circuit which causes the coil to produce a high voltage surge.

True False

5. The power source for the voltage in the ignition circuit comes from the spark plug.

True False

6. The hightest voltage (20,000 volts) is induced in the primary circuit.

True False

7. A long insulator seat allows the electrode to retain maximum heat. This is called a cold plug.

True False

8. When the ignition switch is turned on, current flows from the battery to the primary windings. This current creates a magnetic field around the winding.

True False

9. The distributor controls the spark plug operation and the engine timing.

True False

IGNITION CIRCUIT

ANSWERS

1. true
2. false
3. true
4. true
5. false
6. false
7. false
8. true
9. true

IGNITION CIRCUIT

After each engine part write a "P" if the part is in the primary circuit, "S" if the part is in the secondary circuit.

1. Spark plug _____
2. Ignition switch _____
3. Condenser _____
4. Distributor Rotor _____
5. Distributor Cap _____
6. Distributor contact points _____
7. Coil primary winding _____
8. High tension wire _____
9. Coil secondary winding _____

IGNITION CIRCUIT

ANSWERS

1. S
2. P
3. P
4. S
5. S
6. P
7. P
8. S
9. S

BATTERY

Using the words provided below select the proper word as the best answer to the fill-in-the blank questions that follow. A word may be used more than once.

1. A fully charged 12 volt battery would actually have _____ volts.
2. To remove the battery cables from a battery use a _____.
3. The battery is filled with a solution called _____.
4. Battery electrolyte is made up of _____ and _____.
5. If you have to store a battery for several months, store it in a _____.
6. Sparks, electrical wiring or cigarettes near a battery could cause the battery to _____.
7. The specific gravity of a fully charged battery is about _____.
8. A(n) _____ is used to measure the specific gravity of electrolyte in a battery.
9. A discharged battery would have a specific gravity reading of _____ on the hydrometer.
10. The temperature that is considered to be best for a battery to perform efficiently is _____ degrees F.
11. Battery electrolyte will _____ in your clothing if splashed on them.
12. If you get electrolyte on your skin or eyes you should flush the area with water for _____ minutes.
13. The battery is the source of _____ energy needed to operate the ignition system.
14. When a battery is _____, it converts electricity into chemical energy.
15. When a battery is _____ or producing current, the battery converts chemical energy into electricity.

WORD LIST

hydrometer	water	sulfuric acid
9.6	explode	electrolyte
battery	discharging	1.280
80	charging	1.140
specific gravity	eat holes	baking soda
terminal puller	flammable	freeze
12.6	cool dry place	10 to 15
wet place	electrical	moist place
chemical	burn cycle	

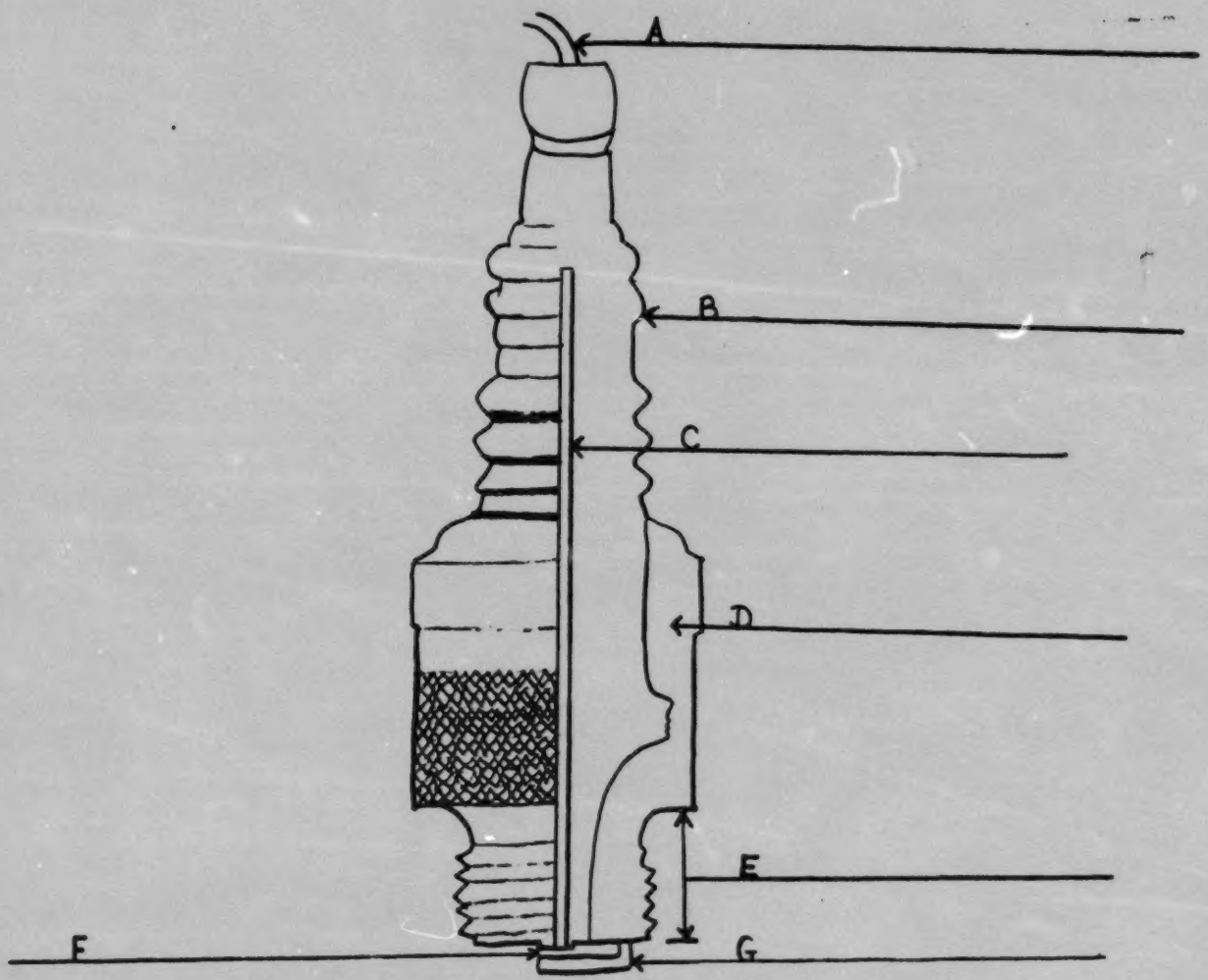
SPARK PLUGS

From the distributor, a high voltage wire carries electrical energy to each of the spark plugs. The function of a spark plug is to provide a timed spark which ignites the _____ mixture in the _____.

A spark plug is made up of three major parts: the electrodes, insulator and the shell. The spark plug is built around a steel rod, the center _____. A wire from the distributor is attached to the top of the electrode, which is insulated by heavy _____ material. High voltage current _____ volts passing down the center _____ jumps the _____ to produce the electrical spark.

Spark plugs are designed for a variety of different types of engines. It is important that the spark plug extend into the _____ just the right amount. Different spark plugs have different heat ranges. The heat range refers to the operating _____ of a given spark plug. Plugs are made to operate at different temperatures depending upon the thickness and length of the ceramic _____. The longer and thinner the insulator tip, the less efficiently the spark plug can transfer heat. This is a _____ plug. The shorter, heavy insulator carries heat well and will operate as a cold plug. All engine manufacturers specify heat ranges for the spark plugs to be used in their _____.

Label the parts of the spark plug.



SPARK PLUGS

ANSWERS

1. Air - fuel
2. cylinders
3. electrode
4. ceramic
5. 20,000 volts
6. electrode
7. gap
8. combustion chamber
9. temperature
10. insulator
11. hot
12. engines

Labels

A. High voltage wire from distributor
B. insulator
C. center electrode
D. shell
E. gap
F. side electrode

THE IGNITION SYSTEM

1. From what does the starter motor receive its power?

( ) solenoid
( ) generator
( ) ground wire
( ) battery

2. The ignition system has a primary and a secondary circuit. The secondary circuit is _____.

( ) low voltage
( ) high voltage

3. The current that reaches the spark plug is _____.

( ) 120 volts
( ) 20,000 volts
( ) 250 volts

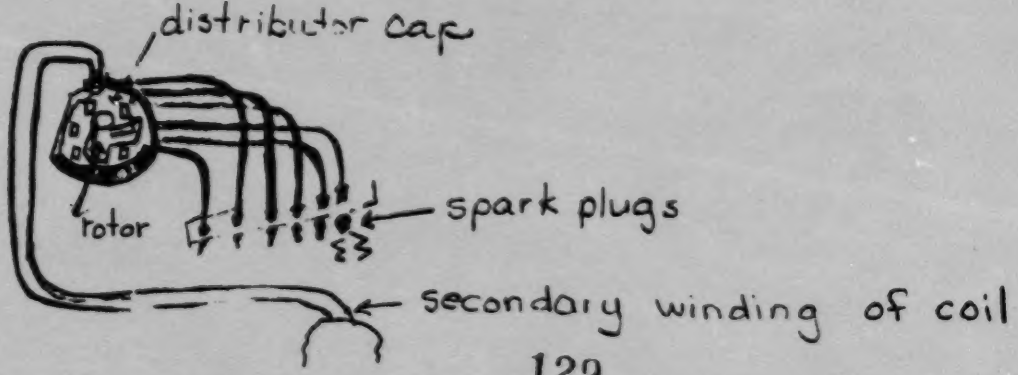
4. Name the two circuits of the ignition system.

1._____
2._____

5. The distributor has two jobs, what are they?

1._____
_____
2._____
_____

6. Distribute means to divide and deal out in shares. Look at this picture of the distributor. The distributor divides and deals out high voltage to the _____.



THE IGNITION SYSTEM

ANSWERS

1. battery
2. high voltage
3. 20,000 volts
4. primary circuit
   secondary circuit
5. 1. Provide the "breaks" or interruptions in the flow of current in the primary circuit which produce the higher voltage in the secondary circuit.
   2. Deliver the higher voltage of the secondary circuit to the spark plug in a series of carefully measured impulses so that each plug fires in the proper order at the right instant.
6. spark plug

SMALL ENGINES - IGNITION SYSTEM

Write the word true or false before the statement.

_____1. The kill switch wire on a magneto ignition system is connected to the secondary wire.

_____2. Armature air gap is the distance between the coil and the points.

_____3. Spark plugs always come preset from the factory.

_____4. Use a round feeler gauge to check spark plug gap.

_____5. A black sooty plug means it is running too lean.

_____6. The flywheel is part of the ignition system.

_____7. Points are checked with a feeler gauge.

_____8. All condensors are the same.

_____9. One side of the primary and secondary coil goes to ground.

_____10. The spark plug is part of the secondary circuit.

_____11. The magnets energize the coil on a battery ignition system.

_____12. 2 cycle engines must have primary compression in order to create secondary compression.

SMALL ENGINES - IGNITION SYSTEM

ANSWERS

1. false
2. false
3. false
4. true
5. false
6. true
7. true
8. false
9. false
10. true
11. false
12. true

Fuel System

PAGE 1

OCCUPATIONAL READING MODULES

OSWEGO COUNTY B.O.C.E.S.

STATE PROJECT #81-3A-9111GS

PROGRAM COORDINATOR:

KATHY FINNERTY

AREA CONSULTANT:

MICHAEL NOTO

PROGRAMMERS:

JIM HURD

MARY KAY MCGIFF

****

PAGE 2

FUEL SYSTEMS

VOCABULARY

FUNCTION

PURPOSE

AIR-FUEL MIXTURE

FUEL TANK

FUEL PUMP

CARBURETOR

AIR-FUEL RATIO

PAGE 3

VOCABULARY (CONTINUED)

ATOMIZATION

PROPORTION

CYLINDER

NEOPRENE

****

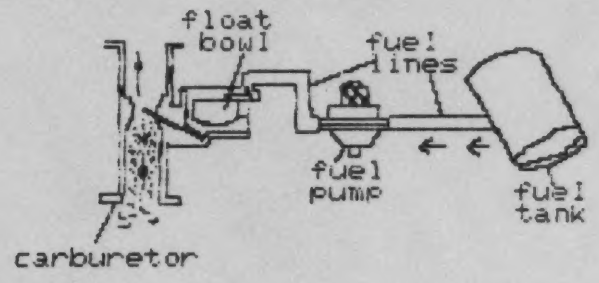
PAGE 4

THE FUNCTION OF THE FUEL SYSTEM IS TO CARRY ENOUGH FUEL FOR MANY DRIVING MILES, AND TO MOVE THAT FUEL FROM THE TANK TO THE CARBURETOR WHERE IT IS MIXED WITH AIR TO BECOME A HIGHLY EXPLOSIVE AIR-FUEL MIXTURE. IT MUST DO THIS UNDER ALL DRIVING CONDITIONS. EXAMPLES: COLD WINTERS, HOT SUMMERS, UP MOUNTAINS AND OVER FLAT LANDS.

PAGE 9
FIGURE 5

FUEL PUMP

The fuel pump sucks, or draws, the gasoline through fuel lines from the fuel tank to the fuel pump. Like pop through a straw.

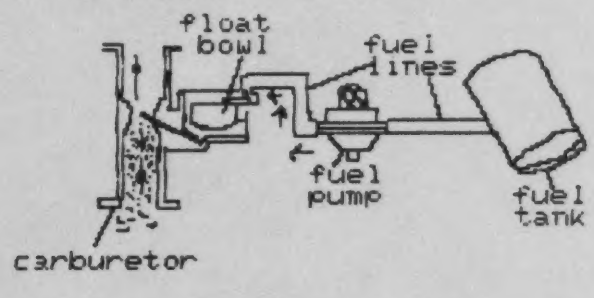


****

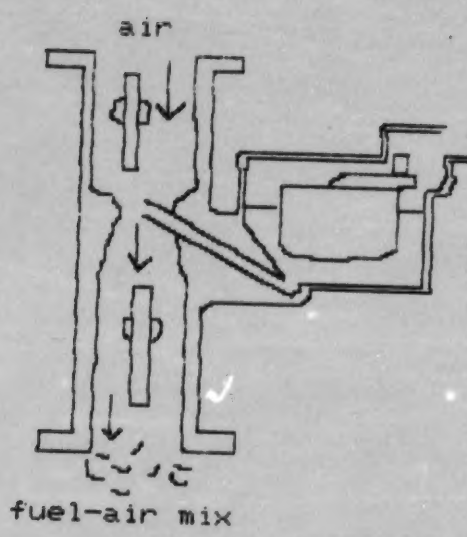
PAGE 10
FIGURE 6

FUEL PUMP

From the fuel pump, the gasoline is pushed through the fuel lines to the float bowl of the carburetor. Like a water pump pushes water to the faucet.



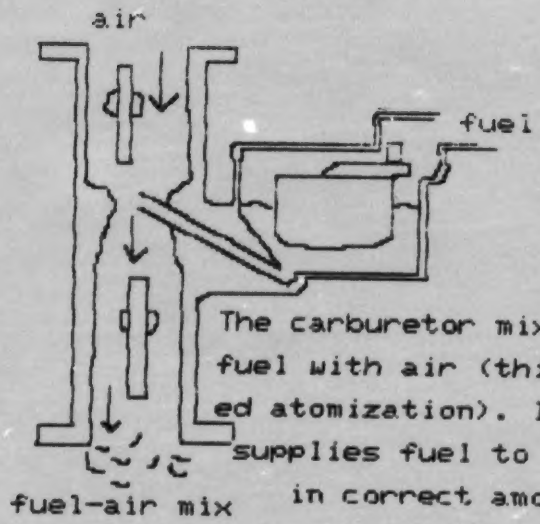
PAGE 11
FIGURE 7



The most important part of the gasoline fuel system is the carburetor.

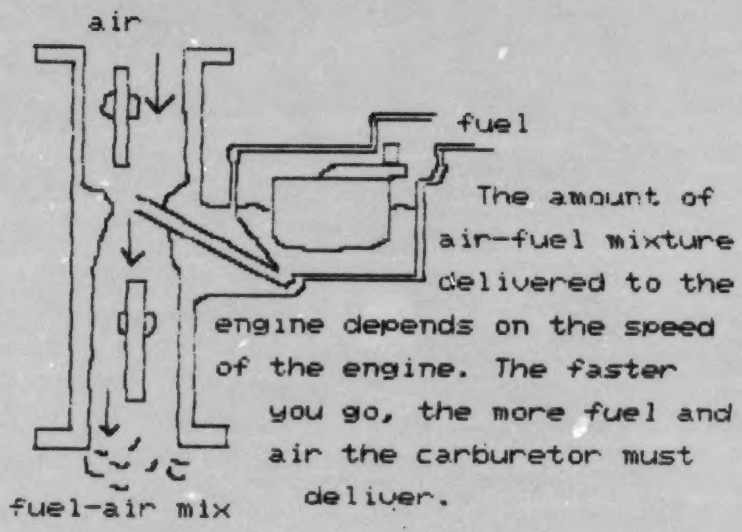
****

PAGE 12
FIGURE 8



The carburetor mixes the fuel with air (this is called atomization). It also supplies fuel to the engine in correct amounts.

PAGE 13
FIGURE 9


air
fuel
The amount of air-fuel mixture delivered to the engine depends on the speed of the engine. The faster you go, the more fuel and air the carburetor must deliver.
fuel-air mix

****

PAGE 14

THE CORRECT PROPORTION OF AIR-FUEL MIXTURE THEN GOES THROUGH THE IN-TAKE MANIFOLD AND TO THE CYLINDER WHERE IT IS BURNED. THE BURNING OF THE AIR AND GAS PRODUCES THE POWER TO TURN THE ENGINE.

PAGE 15
FIGURE 10

****

PAGE 16

1. THE MIXING OF THE AIR AND FUEL
   TAKES PLACE IN THE -----.

   A. FUEL PUMP

   B. FUEL LINE

   C. FUEL TANK

   D. CARBURETOR

PAGE 17

2. THE RESERVOIR OR STORAGE PLACE FOR THE GASOLINE IS THE ---.

A. FUEL PUMP

B. FUEL LINE

C. FUEL TANK

D. CARBURETOR

****

PAGE 18

3. THE ----- PULLS AND PUSHES THE FUEL FROM THE FUEL TANK TO THE CARBURETOR.

A. FUEL PUMP

B. FUEL LINE

C. FUEL TANK

D. CARBURETOR

PAGE 19

4. THE AMOUNT OF THE AIR-FUEL MIXTURE SHOULD BE DELIVERED TO THE ENGINE SHOULD BE CONSTANT, IT SHOULD NEVER CHANGE. ---

A. TRUE

B. FALSE

****

PAGE 20

5. WHICH OF THE PARTS BELOW IS NOT PART OF THE FUEL SYSTEM? ---

A. CARBURETOR

B. FUEL TANK

C. FUEL PUMP

D. RADIATOR

PAGE 21

6. THE ----- CARRIES THE ATOMIZED FUEL FROM THE CARBURETOR TO THE CYLINDER.

A. FUEL PUMP

B. FUEL TANK

C. INTAKE MANIFOLD

D. FUEL LINE

****

PAGE 22

7. THE FUEL LINES ARE MADE OF ---.

A. STEEL AND WOOD

B. COPPER AND BRASS

C. STEEL AND NEOPRENE

D. SUGAR AND SPICE

PAGE 23

TROUBLE SHOOTING QUESTION

8. IF THE FUEL DOES NOT REACH THE CARBURETOR, WHICH WOULD NOT BE A POSSIBLE CAUSE? ---

A. FUEL TANK EMPTY

B. LEAKING CYLINDER

C. BLOCKED FUEL LINE

D. BAD FUEL PUMP

****

PAGE 24

	ANSWERS	PAGE REF.
1	D	12
2	C	6
3	A	10
4	B	13
5	D	5
6	C	14
7	C	8
8	B	0

PAGE 1

OCCUPATIONAL READING MODULES

OSWEGO COUNTY B.O.C.E.S.

STATE PROJECT #81-3A-9111GS

PROGRAM COORDINATOR:

KATHY FINNERTY

AREA CONSULTANT:

MICHAEL NOTO

PROGRAMMERS:

JIM HURD

CHERYL RITCHIE

****

PAGE 2

INTRODUCTION TO THE CARBURETOR

VOCABULARY:

CARBURETOR

AIR HORN

AIR CLEANER

CHOKE ASSEMBLY

GASKET

SEAL

MAIN BODY

BARREL

PAGE 3

CONSTRICTION

VENTURI

PRESSURE DROP

THROTTLE VALVE ASSEMBLY

CYLINDER

ATOMIZATION

EXPLOSIVE

VAPORIZATION

CONDENSATION

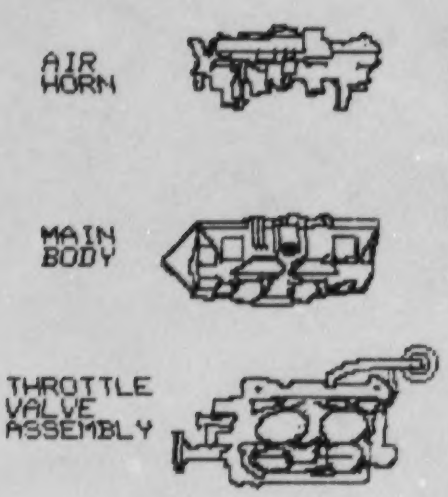
FLOODING

****

PAGE 4

BEFORE SEEING HOW THE CARBURETOR GETS THE FUEL TO THE CYLINDERS IN THE CORRECT AMOUNTS OR THE PROPER AIR-FUEL MIXTURE, THERE ARE SOME BASIC CARBURETOR PARTS AND TERMS TO STUDY.

PAGE 5
FIGURE 1

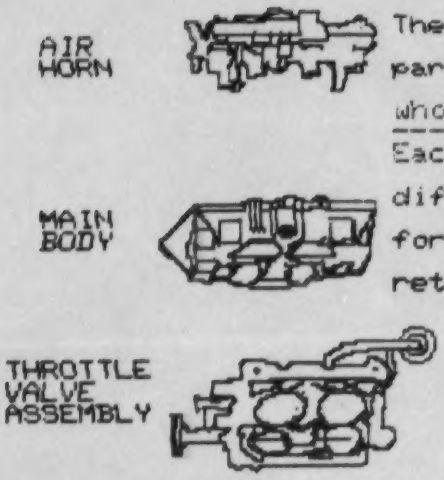


The carburetor usually consists of three major parts. They are:

1. the AIR HORN
2. the MAIN BODY
3. the THROTTLE VALVE ASSEMBLY

****

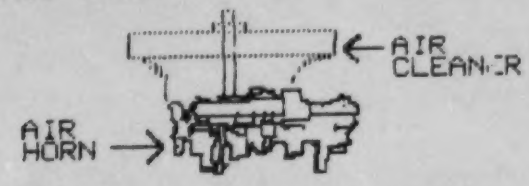
PAGE 6
FIGURE 2



These three major parts make up the whole carburetor. Each one holds different parts for proper carburetor operation.

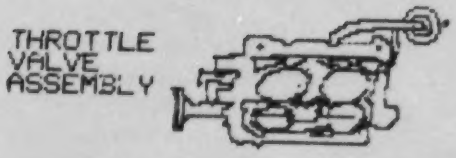
PAGE 7
FIGURE 3

The AIR HORN is the top section of the carburetor. The air cleaner is fastened to this part of the carburetor and the choke assembly. We'll talk more about this later.



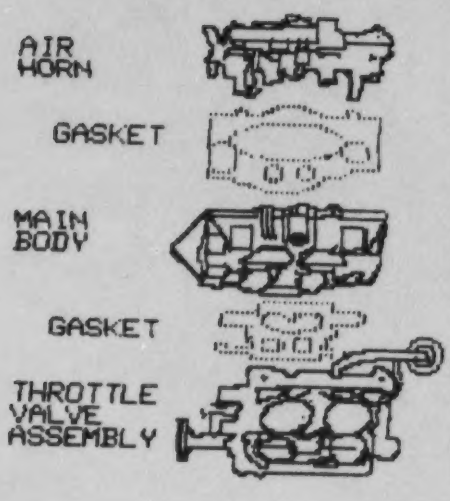
****

PAGE 8
FIGURE 4



The THROTTLE VALVE ASSEMBLY is the the bottom section of the carburetor. It controls the amount of air and fuel that enters the engine.

PAGE 9
FIGURE 5



The main body is sandwiched between the air horn and the throttle valve assembly. Gaskets are used to seal the three main carburetor sections together. The holes in the center of the main body are called barrels. Some carburetors have more than one barrel. The carburetor shown has four barrels.

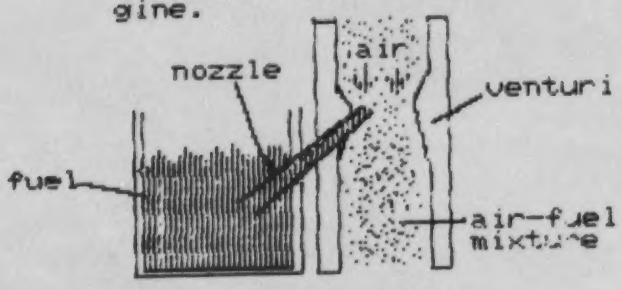
****

PAGE 10
FIGURE 6

Inside the barrel there is a constriction called a venturi.

The venturi has two purposes.

1. It increases air speed going through the carburetor.
2. It causes a pressure drop below the constriction. This pressure drop helps pull the fuel out of the carburetor and into the engine.



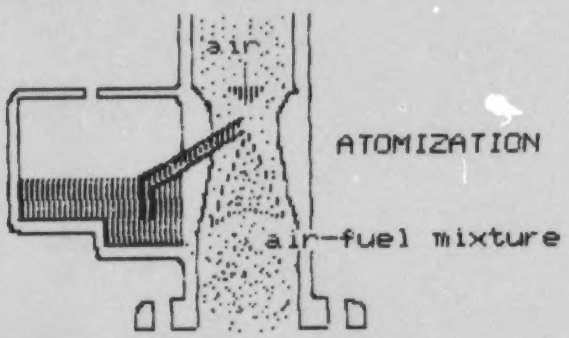
PAGE 11

LET'S LOOK AT SOME VERY IMPORTANT TERMS. THESE TERMS WILL HELP IN UNDERSTANDING THE ACTION THAT TAKES PLACE IN THE CARBURETOR.

****

PAGE 12
FIGURE 7

ATOMIZATION means the breaking down of a liquid into a mist. In a carburetor this must happen in order to make the gasoline highly explosive.



PAGE 13

VAPORIZATION MEANS THE CHANGING OF

A LIQUID INTO A VAPOR. EXAMPLE:
BOILING WATER ON A STOVE PRODUCES
STEAM OR VAPOR.

VAPORIZATION IS DESIRABLE AFTER
THE FUEL HAS PASSED THROUGH THE
CARBURETOR - BUT NOT BEFORE!

****

PAGE 14

CONDENSATION MEANS THE CHANGING OF

A VAPOR OR MIST INTO A LIQUID. IF
THIS HAPPENS AFTER THE FUEL HAS
GONE THROUGH THE CARBURETOR, THE
CAR WILL FLOOD. THIS SIMPLY MEANS
LIQUID FUEL IS PRESENT IN THE
INTAKE MANIFOLD OR CYLINDERS.
FUEL IN THIS FORM WILL NOT BURN
PROPERLY IN THE ENGINE.

PAGE 15

WHEN YOU HAVE THE THREE MAJOR
CARBURETOR PARTS AND THE NEW TERMS
FIRMLY PLANTED IN YOUR HEAD,
WE WILL STUDY CARBURETOR CIRCUITS.

****

PAGE 16

1. THE AIR CLEANER IS FASTENED TO
WHAT MAJOR PART OF THE CARBU-
RETOR? -----

A. THROTTLE VALVE ASSEMBLY
B. MAIN BODY
C. FUEL PUMP
D. AIR HORN

PAGE 17

2. WHAT MAJOR PART OF THE CARBURETOR CONTROLS THE AMOUNT OF FUEL ENTERING THE ENGINE? -----

A. CHOKE ASSEMBLY

B. THROTTLE VALVE ASSEMBLY

C. AIR HORN

D. INTAKE MANIFOLD

****

PAGE 18

3. THE CONSTRICTION THAT INCREASES AIR VELOCITY IS CALLED THE -----.

A. VENTURI

B. GASKET

C. BARREL

D. AIR CLEANER

PAGE 19

4. THE BREAKING DOWN OF A LIQUID
INTO A MIST IS --------.

A. VAPORIZATION
B. ATOMIZATION
C. FLOODING
D. SEPARATION

****

PAGE 20

5. THE TERM FLOODING MEANS LIQUID
FUEL HAS ENTERED THE -----.

A. GAS TANK
B. FUEL PUMP
C. INTAKE MANIFOLD
D. FUEL LINES

PAGE 21

	ANSWERS	PAGE REF.
1	D	7
2	B	8
3	A	10
4	B	12
5	C	14

PAGE 1

OCCUPATIONAL READING MODULES

OSWEGO COUNTY B.O.C.E.S.

STATE PROJECT #81-3A-9111GS

PROGRAM COORDINATOR:

KATHY FINNERTY

AREA CONSULTANT:

MICHAEL NOTO

PROGRAMMERS:

JIM HURD

CHERYL RITCHIE

****

PAGE 2

CARBURETOR CIRCUITS - PART 1

VOCABULARY:

CARBURETOR

CARBURETOR CIRCUIT

FLOAT CIRCUIT

FLOAT BOWL

FLOAT

NEEDLE AND SEAT ASSEMBLY

PRESSURE DROP

FUEL LINE

PAGE 3

FUEL PUMP

SIGNAL

HINGE

IDLE CIRCUIT

ATOMIZE

IDLE

IDLE TUBE

IDLE AIR MIXING SCREW

AIR BLEED

IDLE DISCHARGE HOLE

****

PAGE 4

OFF IDLE DISCHARGE HOLE

THROTTLE

HIGH SPEED CIRCUIT

POWER CIRCUIT

PUMP CIRCUIT

CHOKE CIRCUIT

PAGE 5

THE CARBURETOR IS MADE UP OF SIX DIFFERENT CIRCUITS.

1. FLOAT CIRCUIT
2. IDLE CIRCUIT
3. HIGH SPEED CIRCUIT
4. POWER CIRCUIT
5. PUMP CIRCUIT
6. CHOKE CIRCUIT

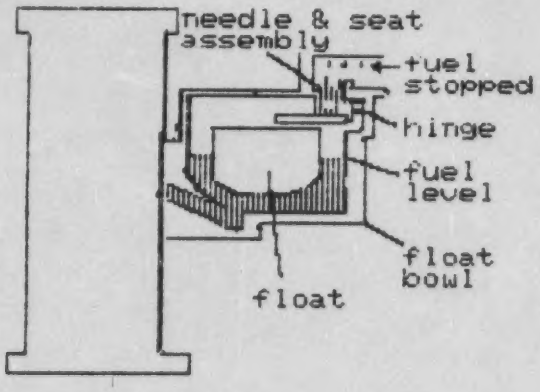
LET'S TAKE A LOOK AT THEM ONE AT A TIME AND SEE HOW THEY WORK TO MAKE UP THE WHOLE CARBURETOR.

****

PAGE 6
FIGURE 1

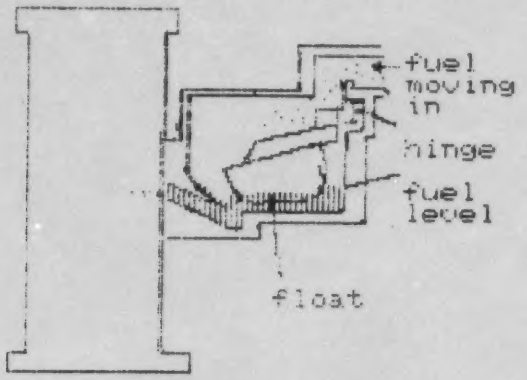
1. THE FLOAT CIRCUIT

Its purpose is to hold enough fuel for all the rest of the carburetor circuits. Its parts consist of the - FLOAT BOWL, the FLOAT and a NEEDLE & SEAT ASSEMBLY.



PAGE 7
FIGURE 2

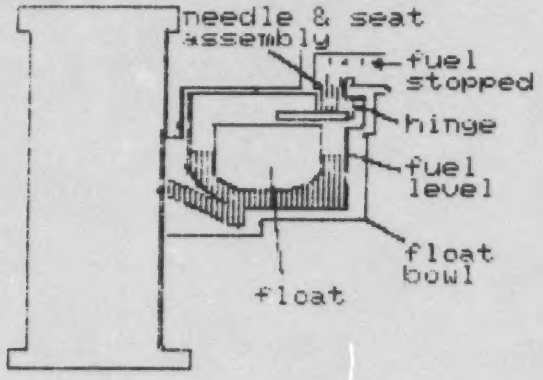
As the engine uses fuel, the float drops opening the needle and seat assembly. This causes a pressure drop in the fuel line coming from the fuel pump. This pressure drop is the FUEL PUMPS SIGNAL to push more fuel to the float bowl.



****

PAGE 8
FIGURE 3

When the bowl gets full, the needle and seat assembly are closed by the float. Thus, no more fuel enters the carburetor until the float drops again. The whole float circuit works like the float assembly in the back of your toilet.



PAGE 9

2. THE IDLE CIRCUIT

THE PURPOSE OF THE IDLE CIRCUIT IS TO PROVIDE ENOUGH ATOMIZED FUEL FOR IDLE AND LOW SPEED OPERATION, 500 RPM TO 2,000 RPM. IDLE CIRCUIT PARTS CONSIST OF AN IDLE TUBE, IDLE AIR MIXING SCREW, AIR BLEED, IDLE DISCHARGE HOLE, AND AN OFF IDLE DISCHARGE HOLE.

****

PAGE 10

THE SECRET OF THE IDLE CIRCUIT IS THE POSITION OF THE THROTTLE VALVE.

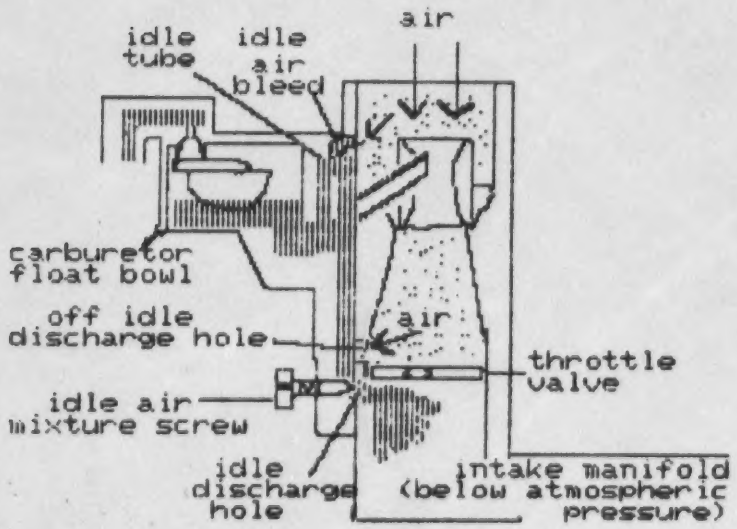
THE IDLE CIRCUIT ONLY WORKS WHEN THE THROTTLE VALVE IS CLOSED OR NEARLY CLOSED. THE IDLE DISCHARGE HOLE IS LOCATED BELOW THE THROTTLE VALVE.

PAGE 11

WHEN THE ENGINE IS IDLING, THE THROTTLE VALVE IS CLOSED SO NO AIR OR VERY LITTLE AIR PASSES THROUGH THE VENTURI. THE AIR IS DRAWN THROUGH THE IDLE AIR BLEED AND THE OFF IDLE DISCHARGE HOLE. THE FUEL AND AIR ARE DISCHARGED BELOW THE THROTTLE VALVE AT THIS POINT.

****

PAGE 12
FIGURE 4

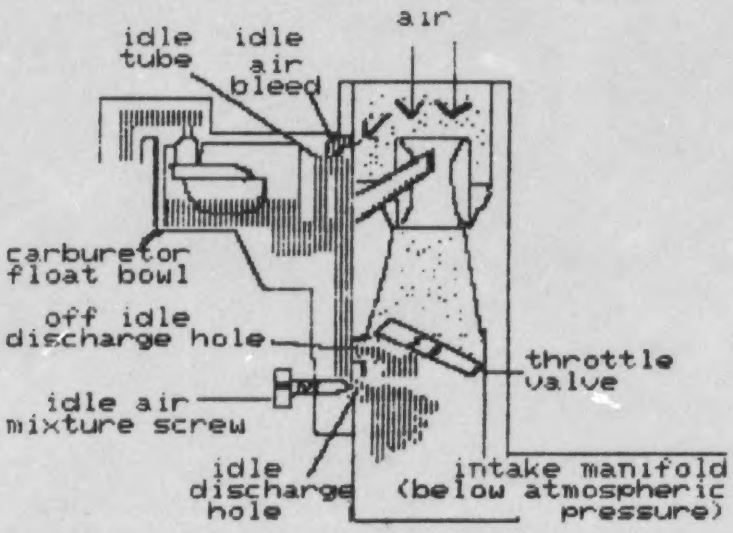


PAGE 13

WHEN THE THROTTLE VALVE IS OPENED SLIGHTLY, FUEL AND AIR ARE DISCHARGED OUT OF THE IDLE DISCHARGE HOLE AND THE OFF IDLE DISCHARGE HOLE. THIS ADDITIONAL FUEL AND AIR HELP TO BRING ABOUT A SMOOTH CHANGE FROM THE IDLE CIRCUIT TO THE HIGH SPEED CIRCUIT.

****

PAGE 14
FIGURE 5



PAGE 15

THIS COMPLETES THE FIRST TWO CIRCUITS. FINISH THIS PART BY ANSWERING THE FOLLOWING QUESTIONS. AFTER ANSWERING THE QUESTIONS, I WOULD RECOMMEND THAT YOU GO THROUGH THIS PART AGAIN AND STUDY THE PICTURES CAREFULLY. WHEN YOU FEEL YOU UNDERSTAND THESE TWO CIRCUITS, GO ON TO CARBURETOR CIRCUITS - PART 2.

****

PAGE 16

1. WHEN THE FLOAT DROPS, THE _____.

   A. NEEDLE AND SEAT ASSEMBLY CLOSES

   B. FUEL ENTERS THE BOWL

   C. FUEL PUMP STOPS

   D. ALL OF THE ABOVE

PAGE 17

TROUBLESHOOTING QUESTION

2. IF THE FLOAT HAD A HOLE IN IT AND FILLED WITH FUEL THE ----.

A. FLOAT WOULD RISE

B. FUEL WOULD NOT ENTER THE CARBURETOR

C. FUEL PUMP WOULD STOP

D. CARBURETOR WOULD FLOOD OVER

****

PAGE 18

3. THE IDLE DISCHARGE HOLE IS LOCATED -----.

A. BELOW THE THROTTLE PLATE

B. SLIGHTLY ABOVE THE THROTTLE PLATE

C. IN THE VENTURI

D. NONE OF THE ABOVE

PAGE 19

4. THE OFF IDLE DISCHARGE HOLE ACTS AS A ----- WHEN THE ENGINE IS IDLING.

A. FUEL SOURCE

B. FUEL PUMP

C. PRESSURE VALVE

D. AIR BLEED

****

PAGE 20

	ANSWERS	PAGE REF.
1	B	7
2	D	0
3	A	11
4	D	11

OCCUPATIONAL READING MODULES

OSWEGO COUNTY B.O.C.E.S.

STATE PROJECT #81-3A-9111GS

PROGRAM COORDINATOR:

KATHY FINNERTY

AREA CONSULTANT:

MICHAEL NOTO

PROGRAMMERS:

JIM HURD

CHERYL RITCHIE

****

CARBURETOR CIRCUITS - PART TWO

VOCABULARY:

HIGH SPEED CIRCUIT

ATOMIZE

IDLE CIRCUIT

OFF IDLE ENGINE OPERATION

THROTTLE

MAIN METERING JET

MAIN WELL

MAIN NOZZLE

PAGE 3

VENTURI

FLOAT BOWL

DISCHARGE

MANUFACTURER

POWER CIRCUIT

POWER VALVE

POWER PISTON

VACUUM

PASSAGEWAY

INTAKE MANIFOLD

****

PAGE 4

3. THE HIGH SPEED CIRCUIT

THE PURPOSE OF THE HIGH SPEED CIRCUIT IS TO PROVIDE AN ATOMIZED FUEL AND AIR MIXTURE FOR ANY SPEED ABOVE OFF IDLE ENGINE OPERATION.

THE HIGH SPEED CIRCUIT PARTS ARE:

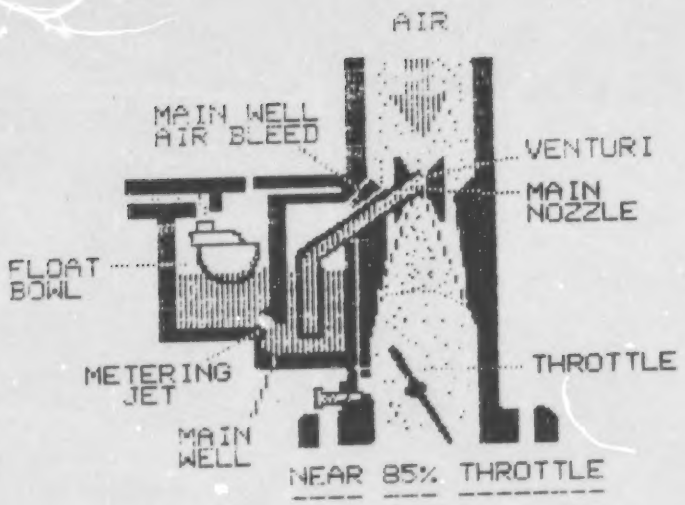
1. MAIN METERING JET
2. MAIN WELL
3. MAIN NOZZLE
4. VENTURI

PAGE 5

THIS IS HOW THE HIGH SPEED CIRCUIT WORKS. FUEL FLOWS FROM THE FLOAT BOWL THROUGH THE MAIN METERING JET INTO THE MAIN WELL. FROM THE MAIN WELL THE FUEL IS DRAWN UP THE MAIN NOZZLE AND DISCHARGED AT ITS TIP. THIS IS WHERE THE FUEL MIXES WITH THE RUSH OF AIR FROM THE VENTURI AND GOES INTO THE ENGINE AS AN ATOMIZED FUEL AND AIR MIXTURE.

****

PAGE 6
FIGURE 1



PAGE 7

THE MAIN POINT TO LEARN IS WHAT CAUSES THIS CIRCUIT TO WORK. REMEMBER, IN THE IDLE CIRCUIT THE THROTTLE VALVE IS CLOSED OR NEARLY CLOSED. SO, THERE IS NO VENTURI ACTION. IN THE HIGH SPEED CIRCUIT THE THROTTLE IS OPEN MORE AND AIR IS DRAWN THROUGH THE VENTURI.

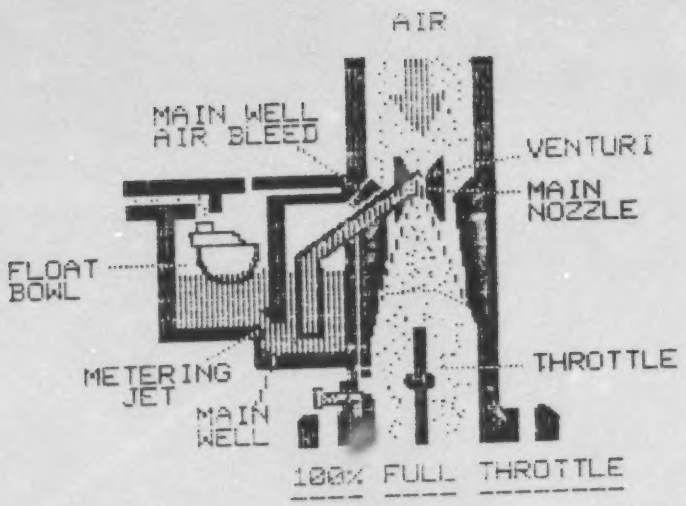
****

PAGE 8

IT IS THIS VENTURI ACTION THAT CAUSES A DROP IN THE PRESSURE AT THE TIP OF THE MAIN NOZZLE AND MAKES THE FUEL COME OUT.

FOR EXAMPLE: THE VENTURI ACTION IS LIKE STANDING TO CLOSE TO A SPEEDING FREIGHT TRAIN. THE TRAIN WILL DRAW YOU RIGHT ALONG WITH IT AS IT PASSES.

PAGE 9
FIGURE 2



****

PAGE 10

THE AMOUNT OF FUEL THAT ENTERS THE ENGINE IS DEPENDENT UPON THE POSITION OF THE THROTTLE VALVE AND THE SIZE OF THE HOLE IN THE MAIN METERING JET. THE LARGER THE HOLE IN THE MAIN METERING JET, THE MORE FUEL ALLOWED IN. THE SMALLER THE HOLE IN THE MAIN METERING JET, THE LESS FUEL ALLOWED IN.

PAGE 11

THE FUEL ALLOWED TO PASS THROUGH THE MAIN METERING JET IS DECIDED UPON BY THE MANUFACTURER OF THE CARBURETOR. BE CAREFUL WHEN SWITCHING A CARBURETOR FROM ONE CAR TO ANOTHER. YOU COULD RUN INTO SERIOUS PROBLEMS.

****

PAGE 12

4. THE POWER CIRCUIT

THE PURPOSE OF THE POWER CIRCUIT IS TO SUPPLY AN ADDITIONAL AMOUNT OF FUEL TO THE HIGH SPEED CIRCUIT FOR VERY HICH SPEED OPERATIONS AND HEAVY LOAD CONDITIONS. THE POWER CIRCUIT ACTS LIKE AN EXTRA MAIN METERING JET, BUT ONLY WORKS DURING THE VERY HIGH SPEED OPERATIONS AND HEAVY LOAD CONDITIONS.

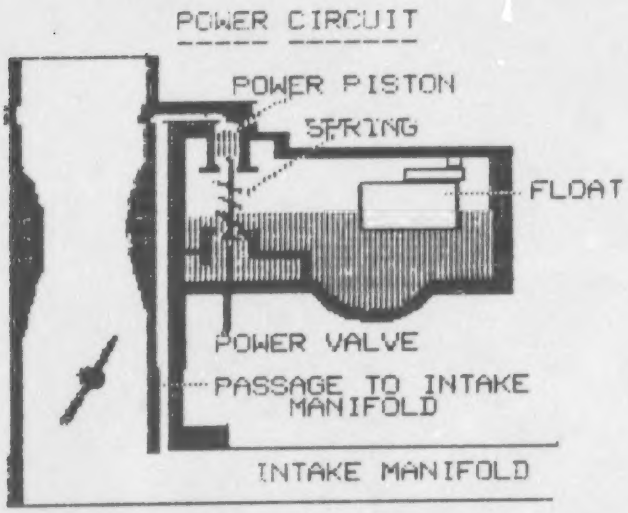
PAGE 13

THE POWER CIRCUIT PARTS ARE:

1. POWER VALVE
2. POWER PISTON AND ROD
3. SPRING
4. PASSAGEWAY TO THE INTAKE MANIFOLD

****

PAGE 14
FIGURE 3

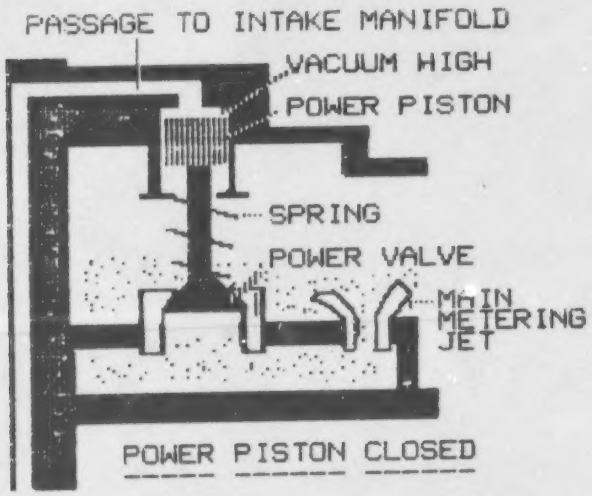


PAGE 15

UNDER NORMAL DRIVING CONDITIONS THE INTAKE MANIFOLD VACUUM IS HIGH. THIS VACUUM HOLDS THE POWER PISTON AND ROD IN THE UPWARD POSITION.

****

PAGE 16
FIGURE 4

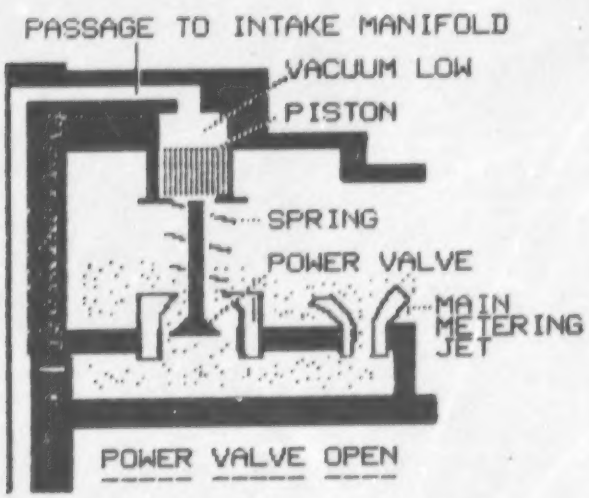


PAGE 17

UNDER HEAVY LOADS OR FULL SPEED DRIVING THE INTAKE MANIFOLD VACUUM DROPS. WHEN THIS HAPPENS, THE RETURN SPRING PULLS THE ROD DOWN AND THE ROD OPENS THE POWER VALVE ALLOWING MORE FUEL INTO THE MAIN WELL, THUS MORE FUEL FOR THE MAIN METERING CIRCUIT.

****

PAGE 18
FIGURE 5



PAGE 19

REMEMBER, THE INTAKE MANIFOLD
VACUUM CONTROLS THE POWER CIRCUIT.
THE DRIVER DOES NOTHING TO MAKE
THE POWER CIRCUIT WORK.

****

PAGE 20

1. WHICH PART LISTED BELOW IS NOT
   A PART OF THE HIGH SPEED
   CIRCUIT? -----

   A. MAIN METERING JET
   B. VENTURI
   C. NEEDLE AND SEAT ASSEMBLY
   D. MAIN NOZZLE

PAGE 21

2. VENTURI ACTION IS WHAT CAUSES THE ----- AT THE TIP OF THE MAIN NOZZLE.

A. AIR PRESSURE INCREASE

B. PRESSURE DROP

C. FLOAT DROP

D. THROTTLE VALVE DROP

****

AGE 22

TROUBLESHOOTING QUESTION

3. IF THE MAIN METERING JET WAS PARTIALLY PLUGGED WITH DIRT, THE ENGINE WOULD -----.

A. RUN ROUGH AT IDLE

B. RUN RICH AT HIGH SPEED

C. RUN LEAN AT HIGH SPEED

D. NOT RUN AT ALL

PAGE 23

4. THE CIRCUIT THAT SUPPLIES ADDITIONAL FUEL TO THE MAIN WELL FOR HIGH SPEED OPERATION IS THE -----.

A. IDLE CIRCUIT

B. CHOKE CIRCUIT

C. POWER CIRCUIT

D. PUMP CIRCUIT

****

PAGE 24

	ANSWERS	PAGE REF.
1	C	4
2	B	8
3	C	0
4	C	12

PAGE 1

CARBURETOR CIRCUITS - PART THREE

VOCABULARY:

PUMP CIRCUIT

SQUIRT

VENTURI

ACCELERATION

LEAN

BOG

STUMBLE

LINKAGE

****

PAGE 2

ACCELERATOR PUMP

PLUNGER SPRING

SEAL

INTAKE CHECK BALL

DISCHARGE CHECK BALL

CHOKE CIRCUIT

MECHANICAL

AUTOMATIC

THERMOSTATIC COIL

BIMETALLIC SPRING

PAGE 3

CHOKE

VACUUM BRAKE DIAPHRAGM

FAST IDLE CAM

HIGH RPM RANGE

RICH AIR-FUEL MIXTURE

INTAKE MANIFOLD VACUUM

OFFSET CHOKE

VERTICAL

NORMAL IDLE RPM RANGE

****

PAGE 4

5. PUMP CIRCUIT

THE PURPOSE OF THE PUMP CIRCUIT IS TO SUPPLY AN ADDITIONAL SQUIRT OF FUEL INTO THE VENTURI AREA UNDER RAPID ACCELERATION. AN ADDITIONAL SQUIRT OF FUEL IS NEEDED BECAUSE, UNDER QUICK ACCELERATION THERE'S A LARGE RUSH OF AIR INTO THE ENGINE. THE AIR IS LIGHT AND CAN MOVE QUICKLY.

PAGE 5

FUEL ON THE OTHER HAND, IS HEAVIER AND DOESN'T MOVE AS QUICKLY AS AIR. IF WE DIDN'T HAVE A PUMP CIRCUIT, THE MIXTURE WOULD BE VERY LEAN CAUSING THE ENGINE TO BOG OR STUMBLE. THE ADDITIONAL SQUIRT OF FUEL FROM THE PUMP CIRCUIT OVERCOMES THIS LEAN CONDITION AND ALLOWS THE ENGINE TO ACCELERATE QUICKLY.

****

PAGE 6

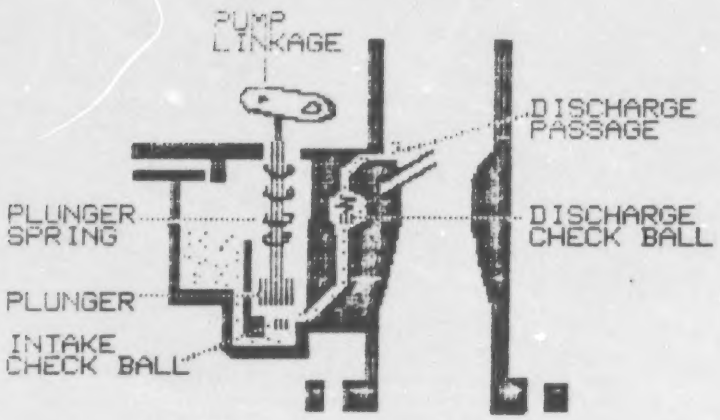
THE PUMP CIRCUIT IS MECHANICALLY CONTROLLED BY LINKAGES OPERATED BY THE GAS PEDAL.

THE PARTS OF THE PUMP CIRCUIT ARE:

1. ACCELERATOR PUMP
2. PLUNGER SPRING
3. INTAKE CHECK BALL
4. DISCHARGE CHECK BALL
5. LINKAGES

PAGE 7
FIGURE 1

PUMP CIRCUIT

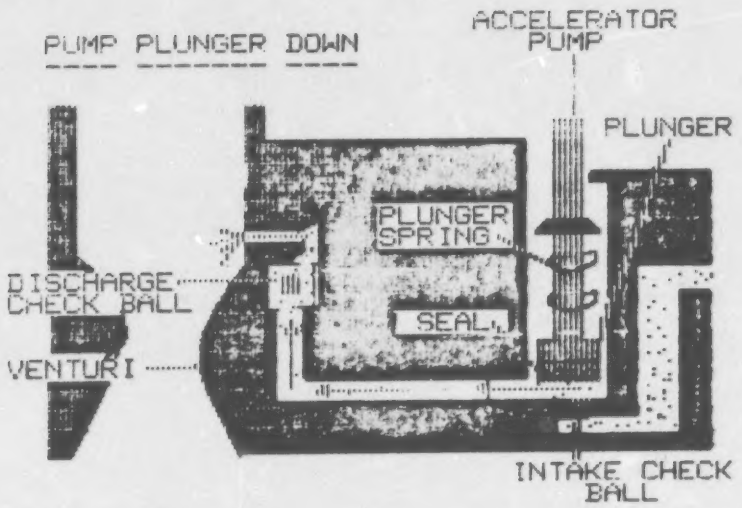


****

PAGE 8

HERE'S HOW THE PUMP CIRCUIT WORKS. WHEN THE DRIVER STEPS ON THE GAS PEDAL THE LINKAGES FORCE THE ACCELERATOR PUMP DOWN. THE SEAL AT THE BOTTOM OF THE PUMP WON'T ALLOW THE FUEL PASSED IT. THE INTAKE CHECK BALL WON'T LET THE FUEL BACK INTO THE FLOAT BOWL. SO, THE FUEL IS FORCED PASSED THE DISCHARGE CHECK BALL AND INTO THE VENTURI.

PAGE 9
FIGURE 2



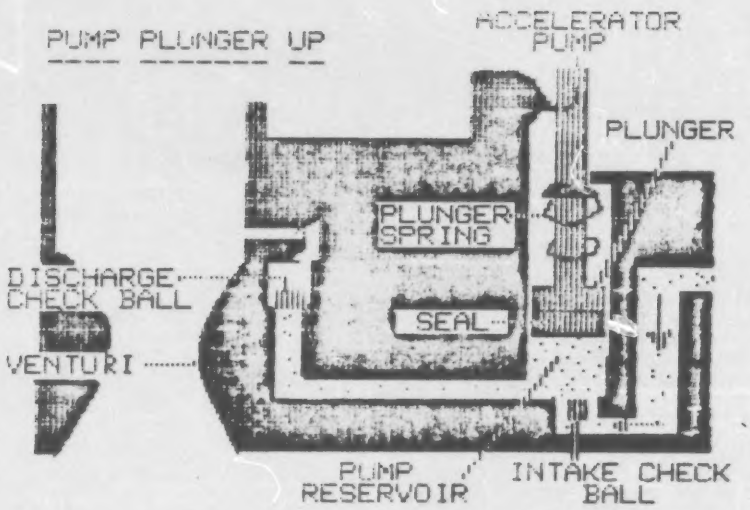
****

PAGE 10

BEING A ONE SHOT DEAL, THE GAS PEDAL MUST BE RAISED IN ORDER TO REFILL THE ACCELERATOR PUMP RESERVOIR.

CHECK THE PUMP CIRCUIT CAREFULLY IF A CUSTOMER COMPLAINS OF A BOG ON ACCELERATION.

PAGE 11
FIGURE 3



****

PAGE 12

6. CHOKE CIRCUIT

THE PURPOSE OF THE CHOKE CIRCUIT IS TO PROVIDE A RICH FUEL MIXTURE FOR STARTING AND RUNNING A COLD ENGINE. THE CHOKE MAY OPERATE MECHANICALLY OR AUTOMATICALLY. THE AUTOMATIC CHOKE IS THE MOST COMMON.

PAGE 13

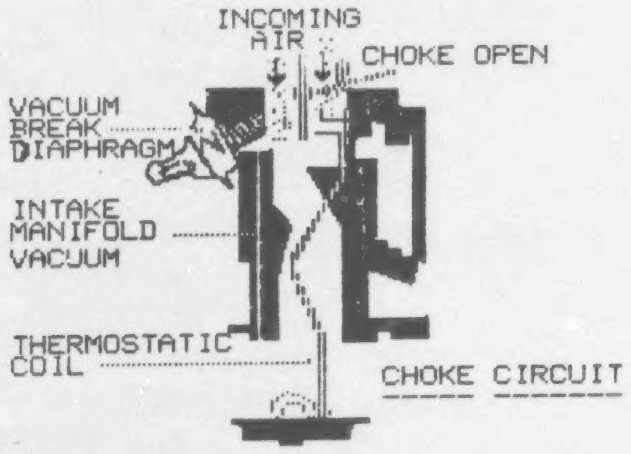
THERE ARE MANY TYPES OF AUTOMATIC CHOKES, BUT THEY ALL SERVE THE SAME PURPOSE.

WE'LL TALK ABOUT THE ONE USING A:

1. THERMOSTATIC COIL (BIMETALLIC SPRING)
2. OFFSET CHOKE
3. VACUUM BRAKE DIAPHRAGM
4. FAST IDLE CAM
5. LINKAGES

****

PAGE 14
FIGURE 4



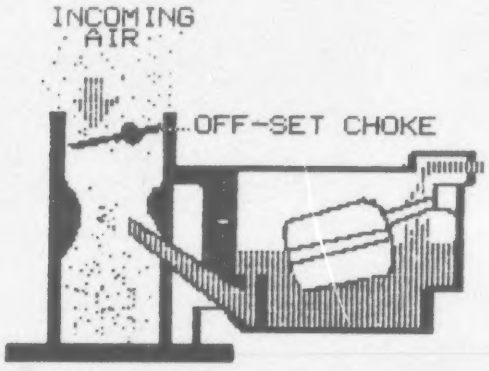
PAGE 15

HERE'S HOW THE CHOKE CIRCUIT WORKS. IN COLD WEATHER THE THERMO-STATIC COIL CLOSES THE CHOKE VALVE AND SETS THE FAST IDLE CAM ON ITS HIGH RPM RANGE.

****

PAGE 16
FIGURE 5

When the engine is turned over to start most of the air is choked off from entering the engine. Therefore, we have a rich air-fuel mixture. (What we need to start and run a cold engine.)

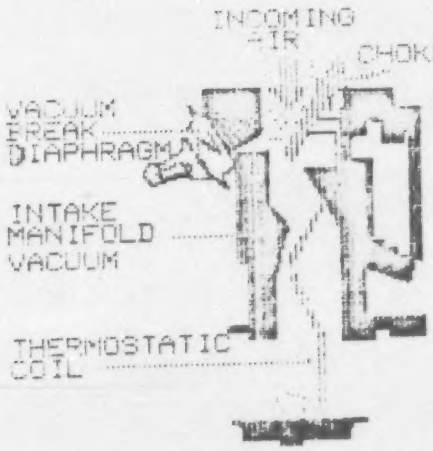


PAGE 17

AS THE ENGINE STARTS, THE INTAKE MANIFOLD VACUUM PULLS ON THE VACUUM BREAK DIAPHRAGM OPENING THE CHOKE SLIGHTLY.

****

PAGE 18
FIGURE 6



As the engine begins to warm up, the thermostatic coil starts to relax and air striking the offset choke upends it, eventually to the vertical position.

PAGE 19

AS THE CHOKE OPENS, THE FAST IDLE CAM DROPS TO THE NORMAL IDLE RPM RANGE AND THE FUEL-AIR MIXTURE IS NOW CORRECT FOR NORMAL OPERATION.

****

PAGE 20

TWO IMPORTANT POINTS:

1. THE THER...STATIC COIL CLOSES THE CHOKE
2. AIR STRIKING THE OFFSET CHOKE OPENS THE CHOKE

THE CHOKE CIRCUIT IS THE CIRCUIT THAT MOST CUSTOMERS COMPLAIN ABOUT. BE SURE TO CHECK EACH CHOKE CIRCUIT IN THE SHOP MANUALS CAREFULLY TO REPAIR IT PROPERLY.

PAGE 21

AFTER GOING THROUGH THIS LESSON TWO OR THREE TIMES AND IF YOU STILL DON'T UNDERSTAND HOW A CIRCUIT WORKS, WRITE DOWN ANY QUESTIONS YOU MIGHT HAVE. SEE YOUR INSTRUCTOR AND HE OR SHE WILL BE GLAD TO HELP.

****

PAGE 22

1. THE PUMP CIRCUIT PROVIDES ADDITIONAL FUEL TO HELP -----.

   A. ACCELERATION

   B. THE ENGINE IDLE PROPERLY

   C. THE ENGINE ADJUST TO HIGH SPEED

   D. NONE OF THE ABOVE

PAGE 23

TROUBLESHOOTING QUESTION

2. IF THE PUMP CIRCUIT SEAL ON THE ACCELERATOR PUMP WAS BAD, THEN THE -----.

A. FUEL WOULD GO BACK TO THE FLOAT BOWL

B. CUSTOMER WOULD COMPLAIN OF A BOG

C. FUEL WOULDN'T ENTER THE VENTURI AREA

D. ALL OF THE ABOVE

****

PAGE 24

3. THE CHOKE CIRCUIT HELPS THE CARBURETOR SUPPLY A ----- TO THE ENGINE.

A. LEAN MIXTURE B. NORMAL MIXTURE

C. FAST MIXTURE D. RICH MIXTURE

4. IN THE CHOKE CIRCUIT, THE THERMOSTATIC COIL -----.

A. OPENS THE CHOKE

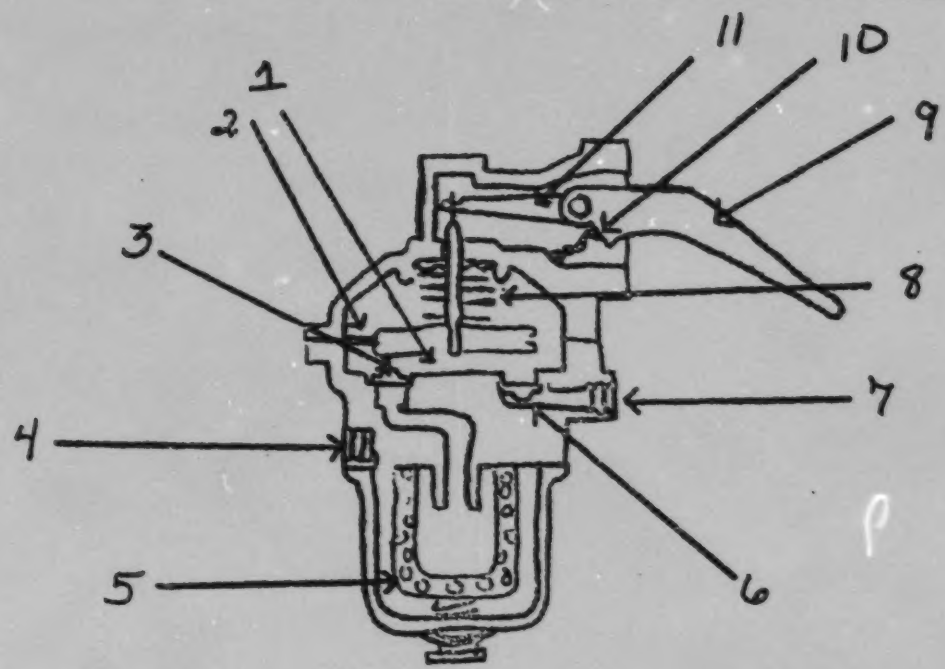
B. CLOSES THE CHOKE

C. DROPS THE FAST IDLE CAM

D. NONE OF THE ABOVE

PAGE 25

	ANSWERS	PAGE REF.
1	A	4
2	D	0
3	D	16
4	B	20



Label 1-11 on this diaphragm-type pump.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____

diaphragm

outlet valve

fuel outlet

chamber "A"

link

rocker arm spring

rocker arm

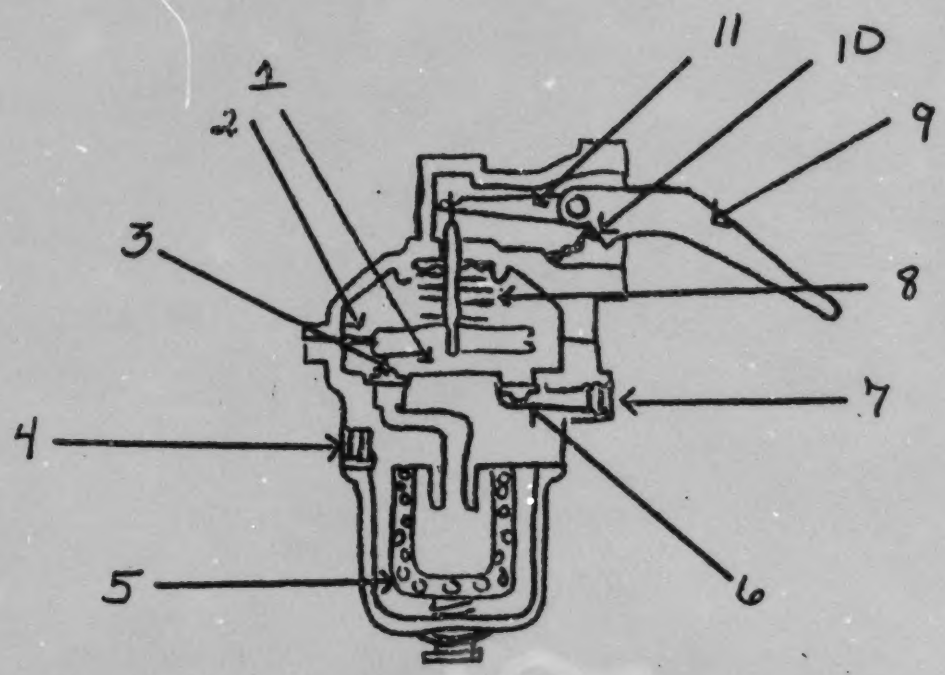
inlet valve

filter

diaphragm spring

fuel inlet

ANSWERS



1. chamber "A"
2. diaphragm
3. inlet valve
4. fuel inlet
5. filter
6. outlet valve
7. fuel outlet
8. diaphragm spring
9. rocker arm
10. rocker arm spring
11. link

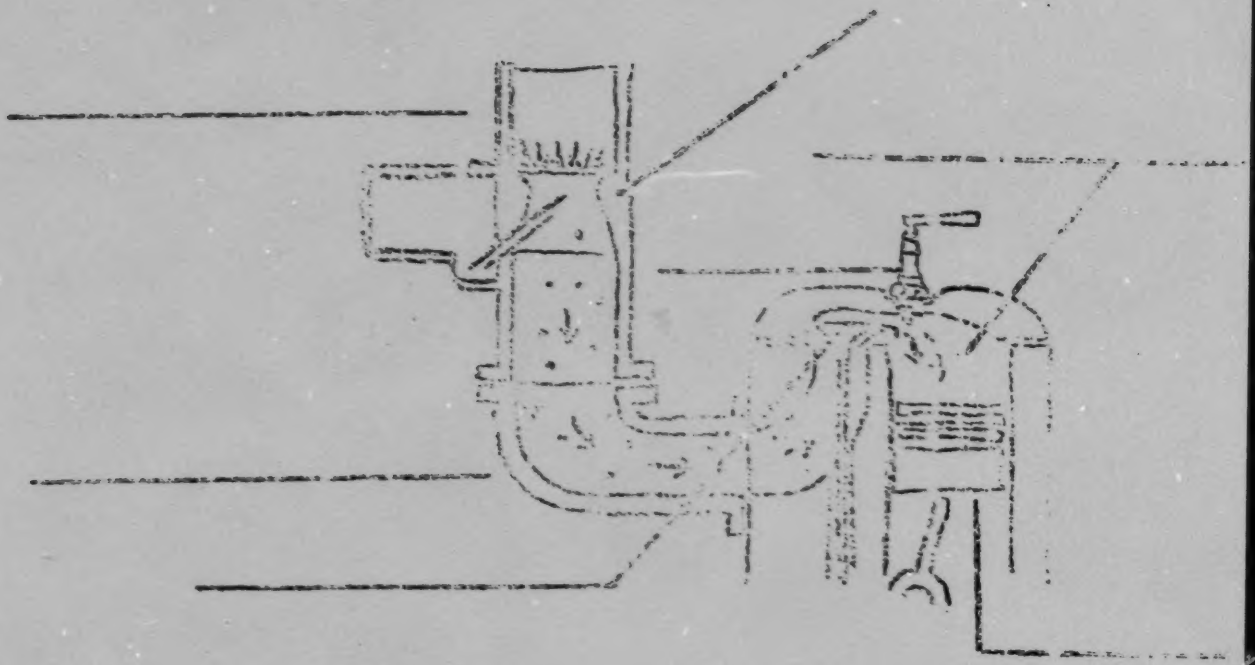
GAS FUEL SYSTEMS

Place an I by the parts of the intake system and an E by the parts of the exhaust system.

1. air inlet _____
2. muffler _____
3. intake valves _____
4. exhaust valves _____
5. turbocharger _____
6. exhaust manifold _____
7. intake manifold _____
8. air cleaner _____

GAS FUEL SYSTEMS - Answers

1. I
2. E
3. I
4. E
5. I
6. E
7. I
8. I

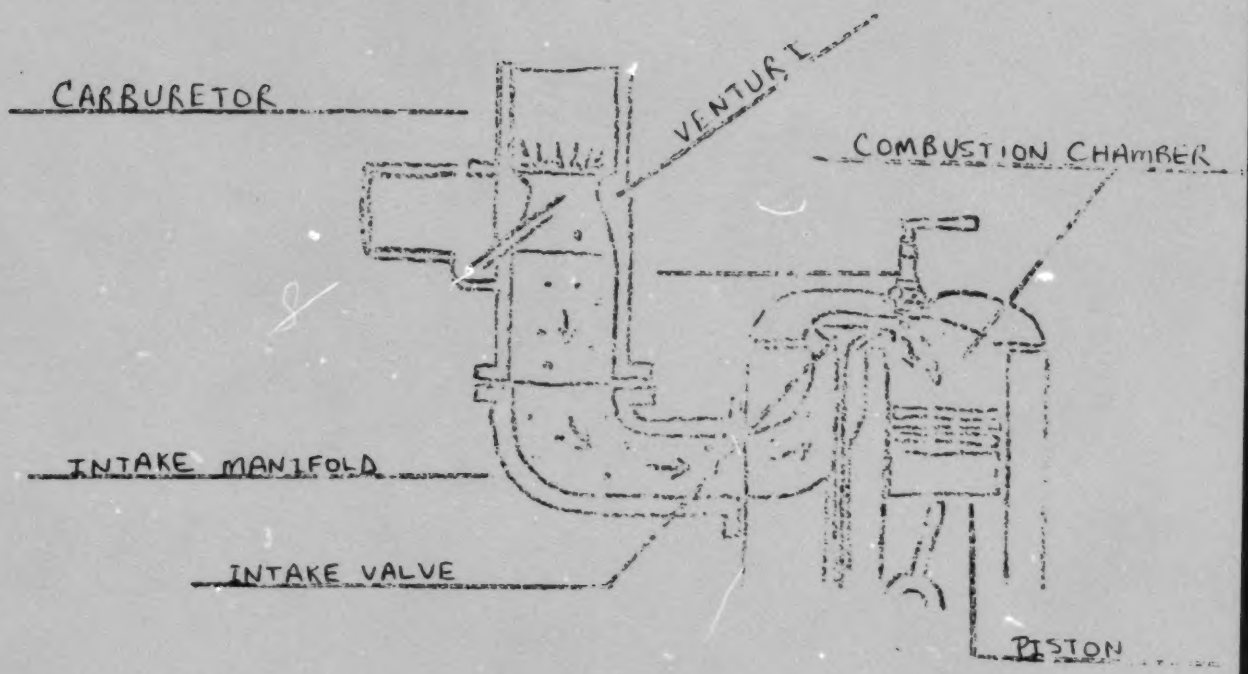


Fill in the blanks in the above diagram using the following words;

piston	conbustion
intake valve	intake manifold
venturi	spark plug
carburetor	

Write down the basic steps of a four stroke cycle engine and what happens in each step.

ANSWERS



intake

compression

power

exhaust

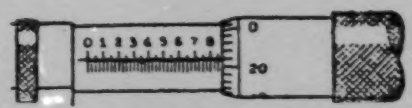
Miscellaneous

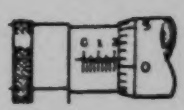
NAME _____

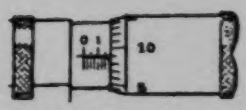
WRITE THE MICROMETER READING IN DECIMALS.

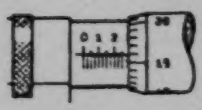
Answers

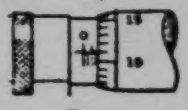
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____

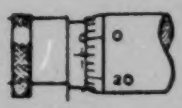

1.

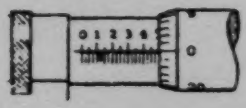

2.

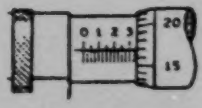

3.

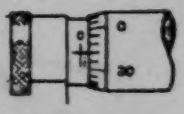

4.

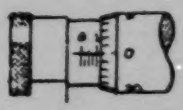

5.

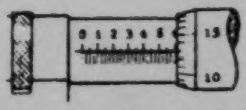

6.

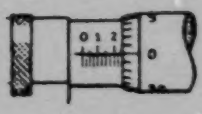

7.

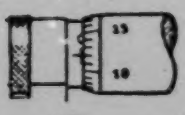

8.


9.


10.

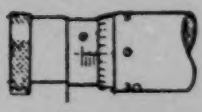

11.

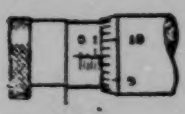

12.


13.

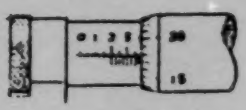
14.

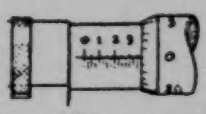
15.


16.

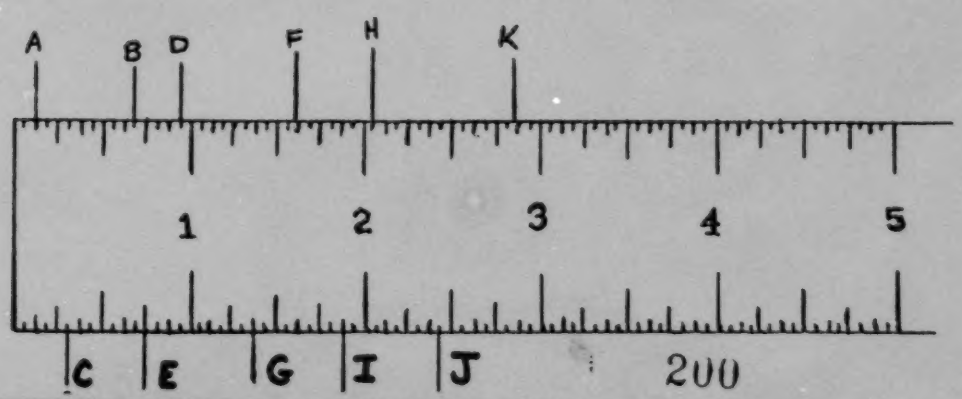

17.

18.


19.


20.

WRITE THE DISTANCE IN A FRACTION IN THE SPACE PROVIDED.



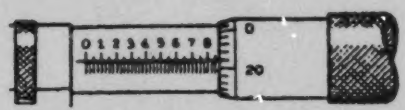
A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K.

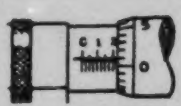
NAME KEY

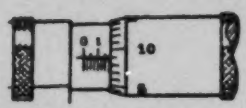
WRITE THE MICROMETER READING IN DECIMALS.

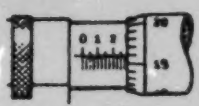
Answers

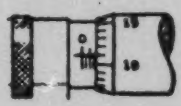
1. .871
2. .226
3. .184
4. .291
5. .086
6. .023
7. .500
8. .342
9. .047
10. .125
11. .613
12. .250
13. .012
14. .079
15. .282
16. .100
17. .133
18. .053
19. .393
20. .375

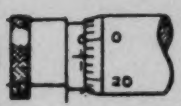

1.

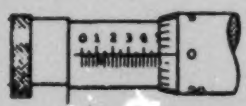

2.

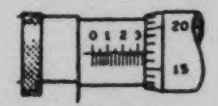

3.

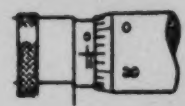

4.

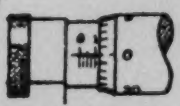

5.


6.

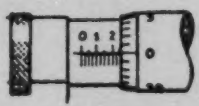

7.

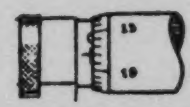

8.

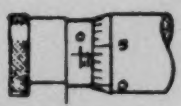

9.

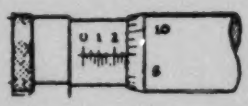

10.

11.

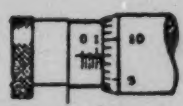

12.

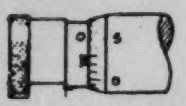

13.

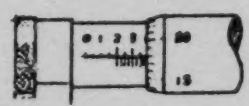

14.


15.

16.

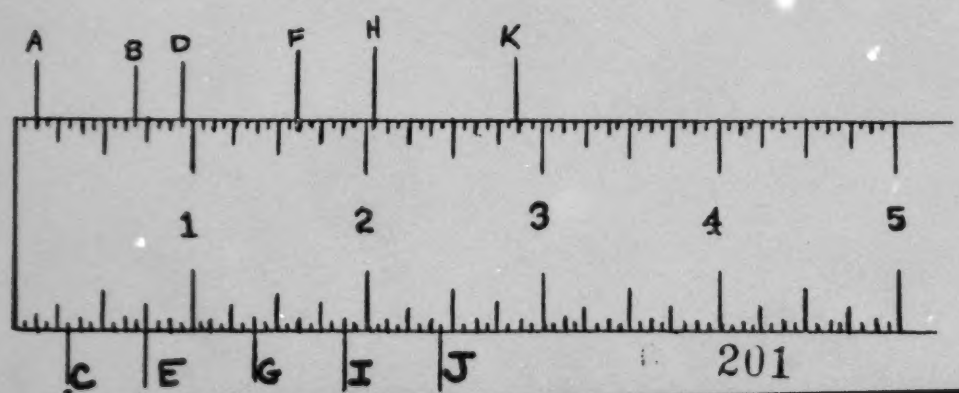

17.


18.


19.

20.

WRITE THE DISTANCE IN A FRACTION IN THE SPACE PROVIDED.



A. 1/8"
B. 11/16"
C. 5/16"
D. 15/16"
E. 3/4"
F. 1 5/8"
G. 1 3/8"
H. 2 1/16"
I. 1 7/8"
J. 2 7/16"
K. 2 7/8"

AUTO SERVICES - TERMS

ACCELERATOR
ADDITIVE
ADVANCE
AMMETER
ARMATURE
AXLE
CALIBRATE
CAMSHAFT
CENTRIFUGAL FORCE
CHASSIS
CHOKE
CIRCUIT
CLEARANCE
CIRCULATION
COMBUSTION
COMPOUND
COMPRESSION
CONDENSATION
CORRODE
CRANKCASE
CRANKSHAFT
CURRENT
DISTILLATION
DYNAMOMETER
ELECTROLYTE
EXHAUST
FLOODING
GASOLINE
GENERATOR
GROUND
KILOMETER
MAGNETO
MAGNETIC
MECHANIC
MECHANICAL
MOTOR
MUFFLER
NEGATIVE
NEUTRAL
OHMMETER
PARALLEL
PREHEATING
PRIMARY
SECONDARY
LINKAGE
REVERSE FLUSH
ROCKER PANEL
ROTARY
ROTATION
SAFETY
SCAVENGING
SEDIMENT
SERIES
SHAFT
SHIFT
SHOCK ABSORBER
SHIMMY
SLUDGE
SPEEDOMETER
STATIC BALANCE
STANDARD
SUSPENSION
SYNCHRONIZE
THERMOSTAT
TORQUE
ODOMETER
VACUUM
VALVE
VAPOR
VOLTAGE

HEAVY EQUIPMENT - SIGHT VOCABULARY

SYNCHROMESH

FEED

BOWL

RIG

PORT

SIPHON

TRANSMISSION

APRON

POWER TAKEOFF

OPEN CUT

PAN

PAVING BREAKER

POND

PREHEATER

DIP

BLOCK

CLUTCH

SAFETY CLUTCH

BIT

STRIPPING

BANK GRAVEL

TRACTOR

BOOM

BOOSTER CABLES

BACKHOE

BLADE

BELT CONVEYOR

DOLLY

CAVE

PUMPING

TRACK

AIR CLEANER

CONSTANT MESH

CUTTER

COLLAR

FINES

STEERING CLUTCH

STEERING BRAKE

A - FRAME

COMPACTION

CLOSING LINE

MUCK

PASS

PIT

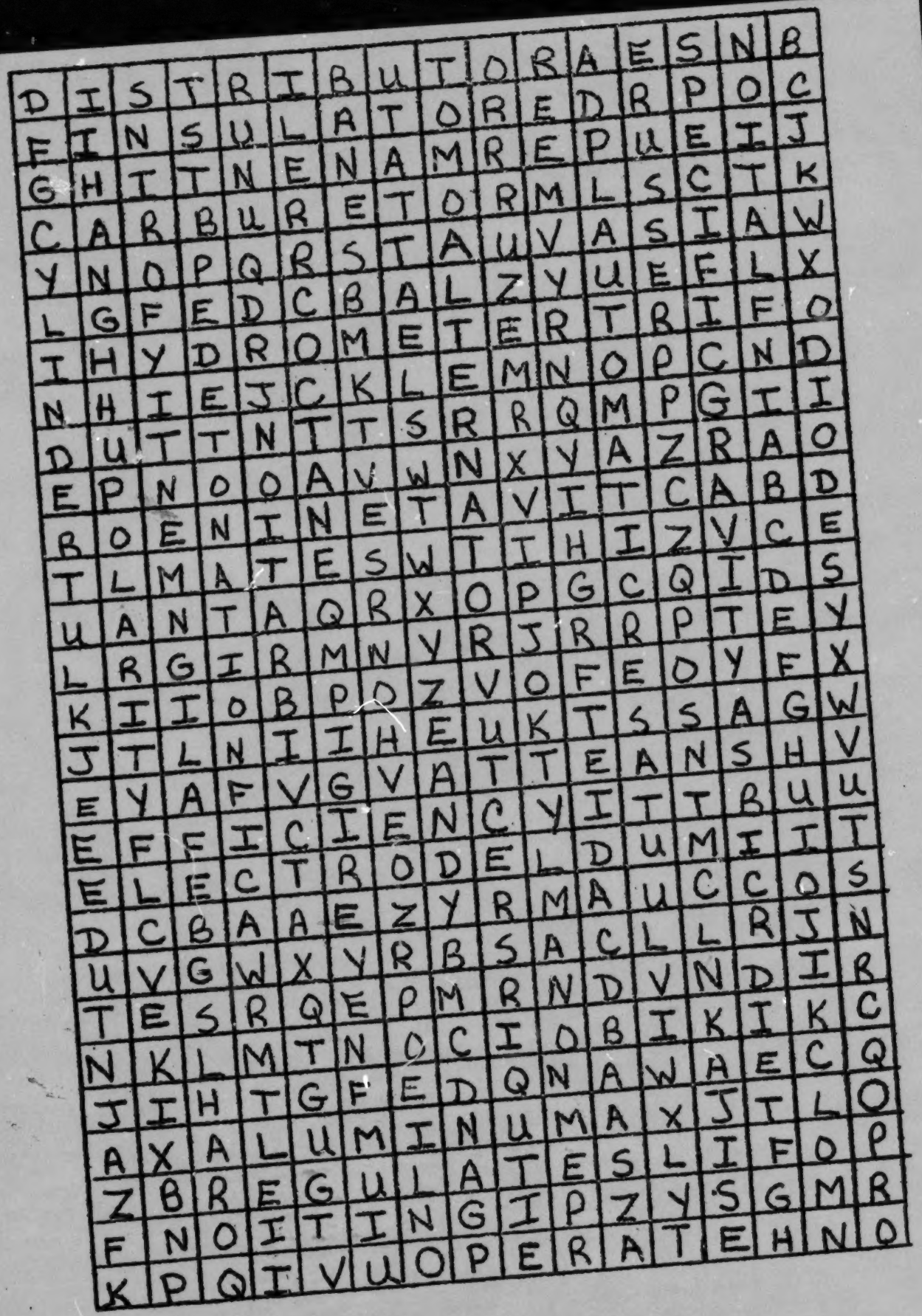
PITCH

CONVEYOR

WORD LIST FOR WORD FIND - AUTO SERVICES

HYDROMETER
DIODES
OCTANE
ALNICO
NEGATIVE
TERMINALS
SPECIFIC GRAVITY
ALTERNATOR
DETONATION
IGNITION
BATTERY
ACTIVATE
POLARITY
INSULATOR
ELECTRODE
CARBURETOR

AUTOMATIC
CIRCUIT
OPERATE
ALUMINUM
INFLATION
DISTRIBUTOR
CYLINDER
ROTATION
EFFICIENCY
PERMANENT
RADIATOR
PRESSURE
REGULATES
ALIGNMENT
VIBRATION


D I S T R I B U T O R A E S N B
E I N S U L A T O R E D R P O C
F H T T N E N A M R E P U E I J
G C A R B U R E T O R M L S C T K
Y N O P Q R S T A U V A S I A W
L G F E D C B A L Z Y U E F L X
I H Y D R O M E T E R T R I F O
N H I E J C K L E M N O P C N D
D U T T N T T S R R Q M P G I I
E P N O O A V W N X Y A Z R A O
R O E N I N E T A V I T C A B D
T L M A T E S W T I H I Z V C E
U A N T A Q R X O P G C Q I D S
L R G I R M N Y R J R R P T E Y
K I I O B P O Z V O F E O Y F X
J T L N I I H E U K T S S A G W
E Y A F V G V A T T E A N S H V
E F F I C I E N C Y I T T R U U
E L E C T R O D E L D U M I I T
D C B A A E Z Y R M A U C C O S
U V G W X Y R B S A C L L R J N
T E S R Q E P M R N D V N D I R
N K L M T N O C I O B I K I K C
J I H T G F E D Q N A W A E C Q
A X A L U M I N U M A X J T L O
Z B R E G U L A T E S L I F O P
F N O I T I N G I P Z Y S G M R
K P Q I V U O P E R A T E H N O

SMALL ENGINES

A customer has his lawn mower serviced. The parts included:

2 - spark plugs at $1.80 each

1 tuneup kit - $4.53 each

1 foam air cleaner $1.57 each

Labor is $12.00 per hour.

1. What is the cost for two spark plugs?

_____

2. What is the cost for all parts?

_____

3. If you worked 3 hours on the engine, how much money should you get for labor?

_____

4. What is the bill for parts and labor?

_____

5. What is the tax on the bill if it is 4% of the total bill?

_____

SMALL ENGINES

ANSWERS

1. $3.60
2. $9.60
3. $36.00
4. $45.70
5. $1.83

HERO - HEAVY EQUIPMENT - FINAL EXAM REVIEW

1. A truck dumping on a fill should always be at right angles to the edge. TRUE FALSE

2. While backing a vehicle to the left, the wheel should be turned to the right. TRUE FALSE

3. Why should you refer to your operators manual before performing maintenance on a machine? _____

_____

_____

4. What is the firing order for a 4 cylinder engine?

_____ or _____

5. Gasoline with higher octane ratings have the least tendency to produce a _____ in the engine.

6. Name the two gases that are combined to make LP-Gas.

   1. _____
   2. _____

7. Name the three jobs of the engine governor.

   1. _____
   2. _____
   3. _____

8. What four functions must engine oils perform to keep todays engines running smoothly?

   1. _____
   2. _____
   3. _____
   4. _____

9. Name the two basic types of filtration systems.

   1. _____
   2. _____

10. What are the two functions of the engine cooling systems?

   1. _____
   2. _____

11. What causes knock in diesel engines?

A. Fuel igniting too slowly.

B. Fuel igniting too fast.

C. None of the above.

12. A 50 percent solution of antifreeze will protect an engine against freezing to _____.

A. 0°F

B. -15°F

C. -34°F

D. -112°F

HERO - HEAVY EQUIPMENT REVIEW

ANSWERS

1. True
2. False
3. The manual is written specifically for the machine.
4. 1,2,3,4 or 1,3,4,2
5. ping or knock
6. butane

   propane
7. 1. maintain a selected speed

   2. limit slow and fast idle

   3. shut down the engine when it overspeeds
8. 1. Reduce wear and friction

   2. Cooling moving parts

   3. Help seal the cylinders

   4. Keep the parts clean
9. 1. by-pass

   2. full flow
10. 1. prevent over heating

    2. regulate temperature
11. A
12. C

TROUBLESHOOTING THE SMALL ENGINE

___1. The failure of the ignition system on the spark test could be due to _____.

A. loss of engine compression
B. defective coil or condensor
C. defects in the fuel system

___2. Engine backfiring could be due to _____.

A. late ignition timing
B. low brake-point gap
C. early ignition timing

___3. You should always disconnect the spark plug wire from the spark plug when working on the engine to prevent accidental _____.

A. shocks
B. backfires
C. starting

___4. Point opening is adjusted on most small engine magnetos with a _____.

A. feeler gauge
B. timing light
C. test light

___5. To check the spark plug gap use a _____.

A. round gauge
B. flat gauge
C. plastigage

___6. If you do not get a spark on the spark test, _____.

A. the engine has lost compression
B. the fuel system is at fault
C. the ignition system is at fault

___7. A common cause of loss of power in a two-cycle engine is _____.

A. clogged exhaust ports
B. valves being hung up
C. worn bearings

___8. If the engine turns over very easily, the engine _____.

A. needs magneto service
B. has lost compression
C. has carburetor or ignition trouble

___9. If the engine starts, sputters and dies under cold weather the _____.

A. fuel mixture is too lean
B. fuel mixture is too rich
C. ignition is faulty

___10. Dirt and carbon buildup on the cylinder and head cooling fins can cause _____.

A. engine overheating
B. engine overspeeding
C. high fuel consumption

___11. If the old piston is scored or worn, then _____.

A. new rings will be required
B. the piston must be refinished
C. a new piston is required

TROUBLESHOOTING THE SMALL ENGINES

ANSWERS

1. B
2. C
3. C
4. A
5. A
6. C
7. A
8. B
9. A
10. A
11. C

The standard fuel for industrial gasoline engines is _____.

This is usually the "regular" gasoline supplied for automobiles, It includes a small quantity of tetraethyl of lead, a poisonous compound that reduces tendency to _____, and/or chemicals to improve performance; together with a dye to give warning of the poison, or to identify make or quality.

Gasoline is classified by _____ rating. Octane is an excellent fuel in anti-knock characteristics, and is given a 100% rating. _____ is a poor anti-knock fuel and is given a 0% rating. The _____ _____ of a gasoline is the octane percentage in a mixture of octane and heptane which it matches in anti-knock valve.

Commercial range now is approximately _____ to _____ for regular gasoline with additives, _____ to _____ for premium quality, and _____ to _____ is expected for aviation gasoline.

The treated and dyed gasoline are perfectly satisfactory in industrisl engines that are used _____. However, in machines that are seldom used gasoline _____ in the carburetor and lines, leaving a gummy deposit that may interfere with starting and operation.

The chief objection to "doped" gasolines on the job is that they are _____, and may be very irritating to the skin, so they should not be used to clean parts, and require special care in handling. The _____ may enter the body through the skin or lungs and cause cumulative poisioning, similar to painter's colic.

Leaded or doped gasoline cannot be used in engines equipped with the catalytic type of combination muffler and exhaust scrubber.

Gasoline engines can also be run on compressed _____ gas, and on various special fuels available in oil production centers. Special tanks, carburetors and other equipment are needed.

POWER PLANTS

ANSWERS

gasoline

knock

octane

heptane

octane number

85 to 90

91 to 95

100 to 115

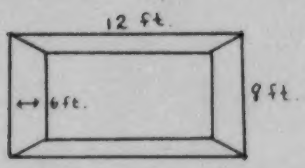
regularly

evaporates

poisonous

lead

butane

1. 

You are asked to dig a foundation for a storage shed. 12 ft. wide by 8 ft. long by 6 ft. deep. How many cubic ft. of soil will you displace?

2. If you work 21 hours digging this foundation and are paid $4.50 an hour, how much money should you get paid?

3. How many days will the job take if you work an 8 hour day?

4. If a system uses 5qts to the coolant in a 20 quart capacity and protects to 10 F, what would be required for a 30qt capacity to be protected to 10 F?

5. When replacing the head a mechanic finds 30 spaces for head bolts but only 21 bolts available. How many must he order?

6. All mechanics in your shop receive a pay raise of $.35 per hour. How much more did each mechanic receive per 40-hour week?

HERO - OPERATIONS AND REPAIR

ANSWERS

1. 576
2. $94.50
3. 2 days 5 hours
4. 7½ quarts
5. 9 bolts
6. $14.00

BRAKES

A brake is a device for _____, _____, or holding an object. A _____ brake performs all three functions, but a tooth or jaw brake is intended only to hold.

Friction brakes turn vehicle or machinery momentum into _____. They usually consist of metal bands or shoes with composition lining on one side, with linkage by which the lining can be forced against a smooth, narrow, cylindrical drum. _____ are ribbons of slightly flexible steel; _____ are rigid pieces shaped to a drum. Brakes that are outside the drum and squeeze inward are called _____ contracting; those that are inside pushing out are _____ expanding.

An external contracting brake band is formed so that it will hold the lining in a nearly perfect _____ around the _____ clearance from the drum is regulated by an _____ _____ which pulls the ends of the band together, and by brackets and set screws which prevent the band from bulging at any point. The brake is applied by pulling the band ends together by means of a _____ in the brake linkage, and released by allowing a _____ to push them apart. The band is flexible enough to pull against the drum with fairly even _____ all the way around, although the pull is at the ends only.

An internal expanding band brake is similar, except that the pressure is outward against the inner surface of the drum.

BRAKES

ANSWERS

slowing

stopping

friction

heat

bands

shoes

external

internal

circle

drum

adjusting bolt

lower

spring

pressure

AUTO SERVICES TERMS-1

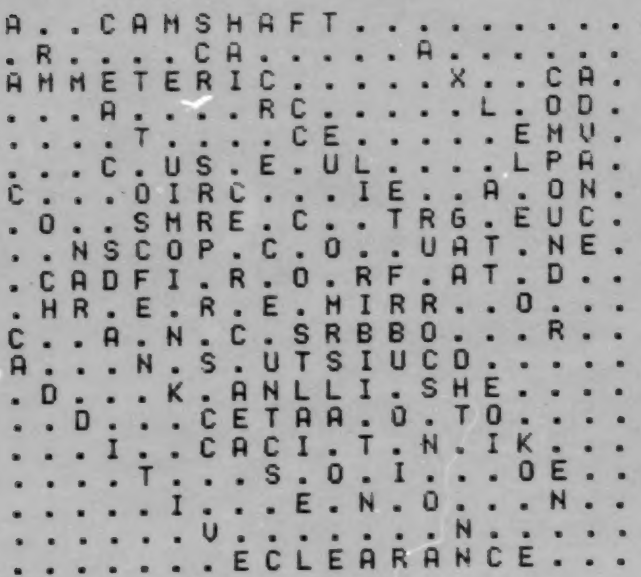
A T J C A M S H A F T C V D W E E K M D
H R E F E E C A J M H O S A T K O P C V
A M M E T E R I C F S F U V X X X C A C
K I M A K B Y G R C C S S M O L R O D L
M X E H T I D I G C E U R P K L E M V N
C P F C J U S Q E O U L E F J M L P A V
C C B G O I R C W S R I E E A A I O N R
S O P P S M R E O C E N T R G Q E U C Q
B D N S C O P J C O O K E U A T Y N E W
B C A D F I C R M O U R F E A T Q D N V
I H R R E B R F E P M I R R S L O E A L
C C M A Q N Z C P S R B B O L U H R T A
A W I X N F S G U T S I U C D P Z V S M
F D V Z I K F A N L L I B S H E G O G L
P Z D T G B C E T A A F O G T O A C N R
D P B I X B C A C I Y T H N E I K X P B
A X G H T F Y R S Y O N I H F B O E K F
H H F Z H I J Q K E X N A O J J C N B E
Z Z I K H O V V X U G T L X N F A F Q I
T J I B G U B E C L E A R A N C E D B C

THERE ARE 21 WORDS HERE - CAN YOU
FIND THEM?

HERE ARE THE WORDS TO LOOK FOR:

ACCELERATOR
ADVANCE
ARMATURE
CALIBRATE
CENTRIFUGAL
CHOKE
CIRCULATION
COMBUSTION
COMPRESSION
CORRODE
FORCE
ADDITIVE
AMMETER
AXLE
CAMSHAFT
CHASSIS
CIRCUIT
CLEARANCE
COMPOUND
CONDENSATION
CRANKCASE

AUTO SERVICES TERMS-1


A C A M S H A F T
R C A A
A M M E T E R I C X C A
A R C L O D
T C E E M V
C U S . E . U L L P A
C O I R C I E A O N
O S M R E C T R G E U C
N S C O P C O U A T N E
C A D F I R O R F A T D
H R E R E S R B B O R
C A N C U T S I U C D
D N K A N L L I S H E
D C E T A A O T O
I C A C I T N I K
T S O I O E
I E N O N
V N
E C L E A R A N C E

AUTO SERVICE TERMS-2

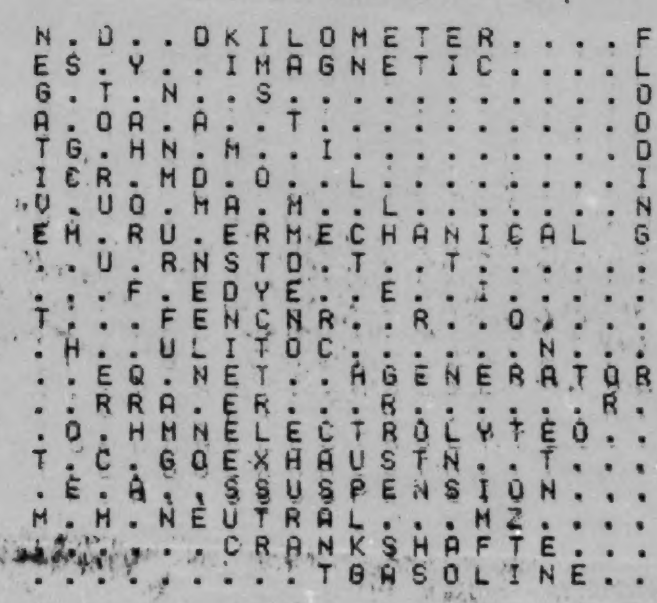
N U D O L D K I L O M E T E R H Z V V F
E S T Y G M I M A G N E T I C Q Q Q F L
G M T L N E A S E J Y S I A K F C N W O
A H O A X A T O T R V D S Y K W M L D O
T G I H N L M V Z I N G H K A B C U Z D
I C R A M D M O E J L M H X L F O T Q I
V W U O O M A L M H J L I L O S T X W N
E M X R U I E R M E C H A N I C A L G
L V U Z R N S T D K T K X T P R F G I K
H C T F K E D Y E Y Y E C L I F P H A B
T F P P F E N C N R Z R R F P O O W F C
W H U R U L I T O C L B Z J D H N G K L
U U E Q T N E T H Q H G E N E R A T O R
L Y R R A A E R O H E R Z E L W J B R S
Q O Y H M N E L E C T R O L Y T E O R C
T O C Y G O E X H A U S T N C D T L B Z
S E Z A M D S S U S P E N S I O N U R N
M R M P N E U T R A L T B N M Z D D A P
Q K D E N V C R A N K S H A F T E G E Z
E T K Y X M W H A T G A S O L I N E Q R

THERE ARE 25 WORDS HERE - CAN YOU FIND THEM?

HERE ARE THE WORDS TO LOOK FOR:

CRANKSHAFT
DISTILLATION
ELECTROLYTE
FLOODING
GENERATOR
KILOMETER
MAGNETO
MECHANICAL
MUFFLER
NEUTRAL
STANDARD
SYNCHRONIZE
TORQUE
CURRENT
DYNAMOMETER
EXHAUST
GASOLINE
GROUND
MAGNETIC
MECHANIC
MOTOR
NEGATIVE
OHMMETER
SUSPENSION
THERMOSTAT

AUTO SERVICE TERMS-2



BEST COPY AVAILABLE

AUTO SERVICES TERMS-3

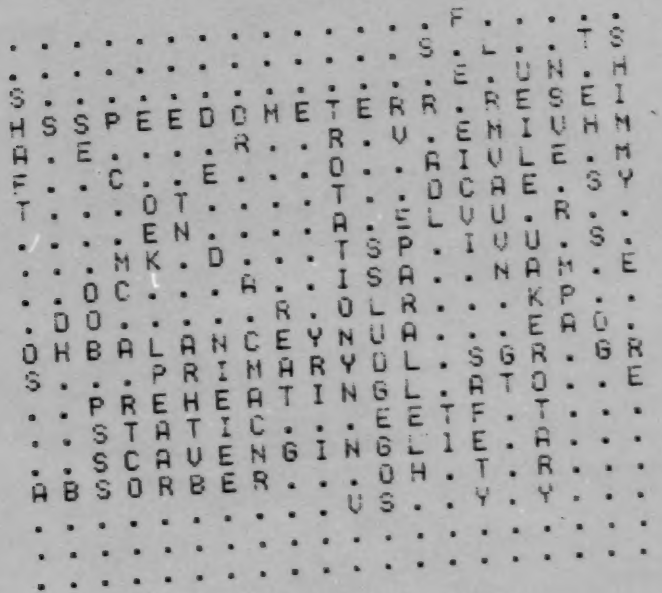
T K Z C S X T Z J R R A S C F Y B Q Z P
F A N L T M D D N R V N I S E L X T T S
S S X W G O O Q P M P G Z P E A U N X H
H S S P E E D O M E T E R R R R E S E I
A B E Q Z A P R U X R H V J E M I V H M
F L U C E J E N A W O N T A I V L E P M
T R X M O T A S R I T W T D C A E W S Y
B M J U E N V Q E E A M E L V U A R N R
D U B M K J D R O E T S P A I V U Q S D
O M O C N F F A C P I S A E M N A M D E
K D O Z F W S Y R A O L R N K S K P B T
O H B A L A N C E Y N U A C I B E A O I
S S Q N P R I M A R Y D L M S G R M G R
V A P R E H E A T I N G L S A T O Q V E
K T S T A T I C W J V E E T F M T U N N
C R S C A V E N G I N G L I E D A K F T
A B S O R B E R O X O O H G T H R R O H
T H U G Y F E E O N V S B P Y C Y K T F
R X M F F G H R S H L L P G J U Q E E J
L G D W O G U K X W I E C L M G S N E T

THERE ARE 27 WORDS HERE - CAN YOU FIND THEM?

HERE ARE THE WORDS TO LOOK FOR:

ABSORBER
FLUSH
ODOMETER
PREHEATING
REVERSE
ROTATION
SCAVENGING
SEDIMENT
SHAFT
SHIMMY
SLUDGE
STATIC
VALVE
VOLTAGE
BALANCE
LINKAGE
PARALLEL
PRIMARY
ROTARY
SAFETY
SECONDARY
SERIES
SHIFT
SHOCK
SPEEDOMETER
VACUUM
VAPOR

AUTO SERVICES TERMS-3



Designed for use with *Fundamentals of Machine Operation, Preventive Maintenance*, 1973 Deere & Company.

Worksheet for pages 2-6

NAME_____ DATE_____

1. What are 3 things preventive maintenance can do?

   _____

   _____

   _____

2. How does preventive maintenance reduce failure and save you money? Circle the correct answers.

   a. less break downs
   b. when crops are in season, machine can do its job
   c. save gas
   d. be more efficient when in use
   e. last longer

3. How can keeping records save your machine?

   _____

   _____

4. Do different tractors have different instructions for maintenance? _____

5. How do you know when and how to keep your machine in good running order? _____

6. What are 4 tips to remember in safe operation of a tractor?

   _____

   _____

   _____

   _____

7. Why is it important to study and understand the owners manual?

   a. because the pictures are nice
   b. to prevent problems with your machine
   c. because the manual is written to waste your time

8. How can the instrument panel save us from potential problems?

   _____

   _____

Answer Sheet

1. reduce failures

   save on operating costs

   keep equipment safe

2. A, B, C, D, E

3. Keep schedule of maintenance checks to increase efficiency of vehicle.

4. yes

5. check manual

6. read manual

   perform proper maintenance

   watch instrument panel

   run engine to warm up when starting

7. B

8. It is a warning system for potential problems.

MOVING THE EARTH

____ 1. quarry	A. A primitive, temporary road built along the route of a job, to provide means for moving equipment and men.
____ 2. quicksand	
____ 3. P.S.I.	B. Any mine, quarry, or excavation area by the open cut method to obtain material of value.
____ 4. pit	
____ 5. oil	C. Total feet of travel of a piston in one minute.
____ 6. pulpwood	
____ 7. pulley	D. Pressure in pounds per square inch.
____ 8. reel	E. A wheel that carries a cable or belt on part of its surface.
____ 9. Pioneer Road	F. wood to be used in making paper.
____10. Piston speed	G. A rock pit.
	H. A revolvong rack used for storage of hose and cable.
	I. find sand or silt that is prevented from settling firmly together by upward movement of ground water.
	J. any liquid petroleum derivative that is less volatile than gasoline. Any fluid lubricant.

MOVING THE EARTH

ANSWERS

1. G
2. I
3. D
4. B
5. J
6. F
7. E
8. H
9. A
10. C

Study Guides for Small Engines

These Study Guides were designed to be used in conjunction with Chapters 1-14 of the Small Gas Engines (Goodheart-Wilcox Company, Inc., 1975) textbook. Some chapter guides may however be adapted for use with other mechanic cluster areas.

Name: _____

Small Engines
Ch. 1 - Study guide

FILL IN THE BLANK

1. A gasoline engine is an _____ _____ engine.

2. When the engine is cranked, the gasoline is _____ (reduced to minute particles) and mixed with _____.

3. Gasoline is a _____ fuel (mixture of hydrogen and carbon), refined from petroleum.

4. Premium grade gasoline burns _____ than regular gasoline.

5. Vapor from the surface of the liquid, combined with _____, is what burns rapidly.

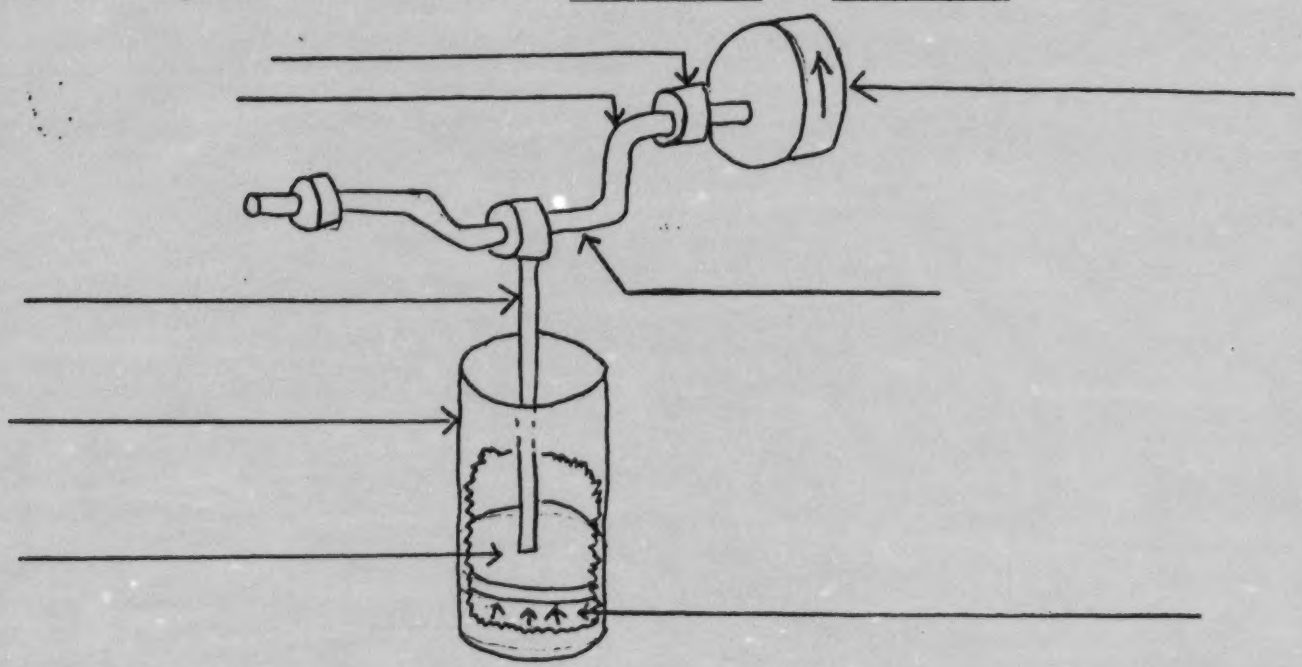
6. To produce the rapid burning required in an engine, the gasoline must be broken up into tiny droplets and mixed with _____. This is called _____.

7. To perform useful work, the explosive force caused by the burning gas must be _____ and _____.

8. The bearings which support the crankshaft are called _____ _____.

9. Because it keeps all parts of the engine in alignment, the _____ _____, is a critical part of the engine.

10. The size, thickness, spacing, and direction of the cooling fins is carefully engineered for efficient air _____ and _____ control.



↑ Fill in the names of the parts of this gasoline engine.

Ch. 1 cont'd.

11. The cylinder block must be _____ and _____ enough to contain the power developed by the expanding gases.

12. The crankshaft is the major _____ part of the engine.

13. The crankcase must be designed to protect the _____ _____.

14. The _____ is the straight line driving member of the engine.

15. The piston provides a seal between the _____, _____ and the _____.

16. The sliding piston is connected to the rotating crankshaft with a metal link called a _____ _____.

17. _____ gases push the piston toward the crankshaft, causing the connecting rod to turn the shaft.

18. During the period of expansion of the _____ _____ that drive the piston downward, both valves are tightly closed.

19. For the engine to function properly, the valves must be opened the _____ _____ at the _____ _____.

20. Generally, the _____ is located in the crankcase, directly below the valve stems and valve lifters.

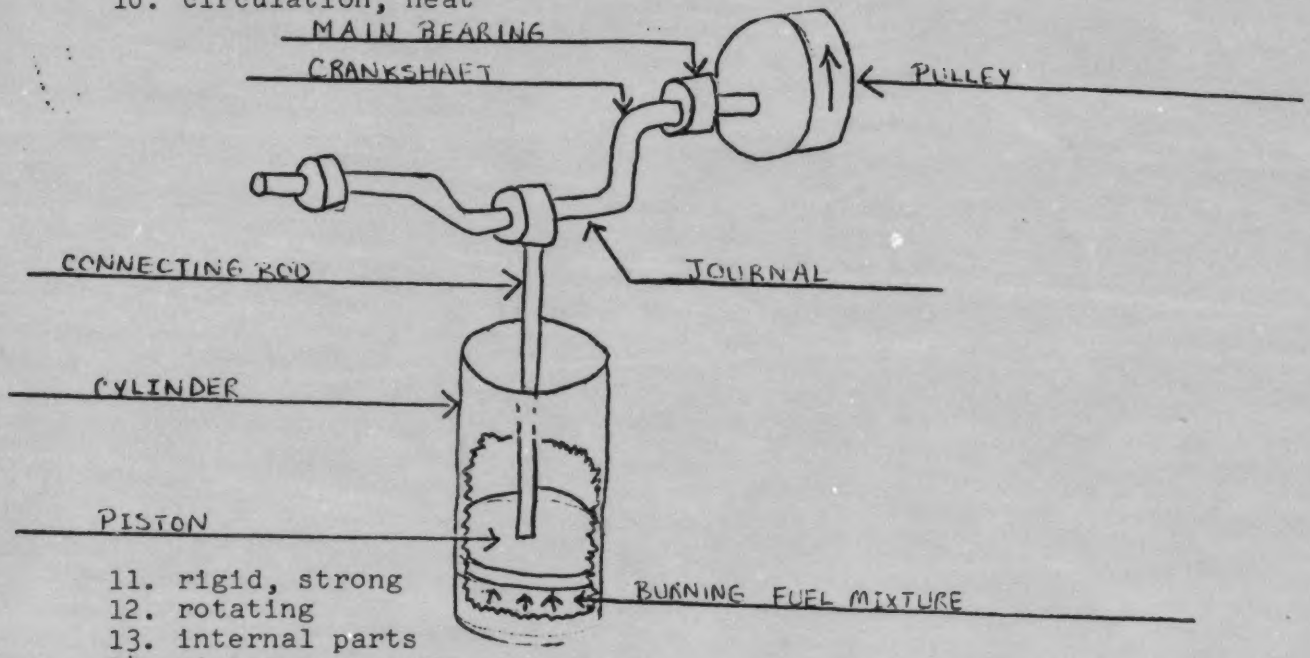
21. The camshaft gear is always twice as large as the _____ _____.

22. _____ cast into the flywheel produce electrical current for the ignition system.

SMALL ENGINES - CH.1 STUDY GUIDE

ANSWERS

1. internal combustion
2. atomized, air
3. hydrocarbon
4. slower
5. oxygen
6. air, atomizing
7. contained, controlled
8. main bearings
9. cylinder block
10. circulation, heat



11. rigid, strong
12. rotating
13. internal parts
14. piston
15. combustion chamber, crankshaft
16. connecting rod
17. Expanding
18. burned gases
19. right amount, right time
20. camshaft
21. crankshaft gear
22. Magnets

Name: _____

Small Engines
Ch. 2 Study Guide

1. A _____ of the piston is its movement in the cylinder from one end of its travel to the other.

2. With the intake valve open during the intake stroke, _____ _____ outside the engine forces air through the carburetor.

3. _____ is a squeezing action while both valves are closed.

4. During the _____ _____, both valves remain in the closed position.

5. Most engines have the spark timed to ignite the fuel slightly before the piston reaches _____ _____ _____ (TDC) of the compression stroke.

6. The removal of gases from the cylinder is called _____.

7. There are two basic types of two cycle engines in general use: _____ & _____

8. The _____ of ports in a two cycle engine is essential to correct timing of the intake, transfer and exhaust functions.

9. As the piston moves upward in the cylinder of a two cycle engine, _____ _____ drops and the intake port is exposed.

10. How many power strokes are there in a four-cycle and a two-cycle engine?

SMALL ENGINES - CH.2 STUDY GUIDE

ANSWERS

1. stroke
2. atmospheric pressure
3. compression
4. power stroke
5. Top Dead Center
6. scavenging
7. cross-scavenging, loop-scavenging
8. location
9. crankcase pressure
10.

4 cycle	2 cycle
1 every 2 revolutions of crankshaft	1 every revolution of crankshaft

Name: _____

Small Engines
Ch. 3 Study Guide

1. _____ is the most popular of all small engine fuels.

2. For small engines, most manufacturers specify the use of _____ grade gasoline with an octane rating around _____.

3. Gasoline should be _____, _____ _____ _____ and reasonably _____.

4. _____ burns clean and leaves few combustion chamber deposits.

5. _____ _____ generally will cause a horsepower loss of around 20 percent when compared with gasoline.

6. The true diesel engine uses diesel fuel injected into the cylinder where it is ignited by the _____ of _____.

7. Most two cycle engines receive _____ only from the oil mixed with the gasoline.

8. Small engine fuel tanks are made of _____ or _____.

9. The purpose of a fuel tank filler cap with a screw vent is to prevent fuel _____ when it is closed.

10. Fuel tanks used in all terrain vehicles (ATVs) and snowmobiles often have the fuel _____ line inserted from the top of the tank.

11. _____ _____ are used on engines having the fuel tank mounted in such a way that a gravity fuel supply system will not operate.

12. Fuel pumps provide constant fuel flow under pressure to the _____ under changing conditions.

13. The _____ _____ is for use when, for some reason, the carburetor float bowl or pump bowl has become empty.

14. One type of _____ fuel pump sometimes used on small gas engines is activated by the pulsing vacuum in the intake manifold or crankcase.

15. Four cycle engines use the intake _____ vacuum; two cycle engines use _____ vacuum.

16. _____ fuel system is used when fuel tanks are located a considerable distance below the carburetor.

17. If the temperature of the air around or inside a carburetor becomes high enough to _____ the gasoline, pockets of vapor will stop all flow of fuel.

18. One of the best ways to prevent vapor lock is to use a carburetor with a _____ _____ _____.

SMALL ENGINES - CH.3 STUDY GUIDE

ANSWERS

1. Gasoline
2. regular, 90
3. clean, free from moisture, fresh
4. LP-Gas
5. Natural gas
6. heat, compression
7. lubrication
8. metal, plastic
9. evaporation
10. pick-up
11. Fuel pumps
12. carburetor
13. hand primer
14. diaphragm
15. manifold, crankcase
16. Pressurized
17. vaporize
18. vapor return line

Name: _____

Small Engines
Ch. 4 Study Guide

1. A _____ primary purpose is to produce a mixture of fuel and air to operate the engine.

2. Gasoline engines cannot run on "_____" gasoline.

3. The air-fuel mixture that results is forced into the intake manifold by _____ _____, then burned in the _____ chamber of the engine.

4. The amount of _____ needed for combustion is far greater than the amount of _____ required.

5. A carburetor is a device that is operated by _____ differences.

6. An _____ _____ is any area completely free of air or atmospheric pressure.

7. The pressure produced by the weight of air molecules above the earth is called _____ _____.

8. A _____ is a restriction in a passage which causes air to move faster.

9. The three basic types of carburetors are named according to the direction in which the air flows from their outlets to the engine manifold:
   1. _____
   2. _____
   3. _____

10. The purpose of the _____ _____ is to maintain a constant level of fuel in the float bowl.

11. The main purpose of the throttle valve is to regulate the amount of _____ mixture entering the cylinders.

12. An acceleration well is a reservoir of _____.

13. The _____ _____ is designed to retard fuel flow to the engine at part throttle.

14. The primer is a _____ plunger which, when depressed, forces additional fuel through the main nozzle prior to starting a cold engine.

15. The diaphragm carburetor does not have a _____ system.

16. A basic _____ throttle control consists of either mechanical linkage or a flexible cable.

Name: _____

Small Engines
Study Guide
Ch. 4 cont'd.

17. What are the 3 basic functions of governors?
    1. _____
    _____
    2. _____
    _____
    3. _____
    _____

18. The _____ _____ governor is operated by the stream of air created by the flywheel cooling fins.

19. The _____ governor speed setting can be changed by using a remote control cable.

20. Three types of air cleaners widely used in small gasoline engines are the _____ _____, _____ _____, and _____ _____.

SMALL ENGINES - CH.4 STUDY GUIDE

ANSWERS

1. Carburetor's
2. liquid
3. atmospheric pressure, combustion
4. air, fuel
5. pressure
6. absolute vacuum
7. atmospheric pressure
8. venturi
9. 1. natural draft or side draft
   2. updraft
   3. downdraft
10. carburetor float
11. air-fuel
12. fuel
13. economizer circuit
14. hand-operated
15. float
16. manual
17. 1. Maintain a speed selected by operator which is within range of governor.
    2. Prevent overspeeding that may cause engine damage.
    3. Limit both high & low speeds.
18. air vane
19. centrifugal
20. oil bath, oil wetted, dry types

Name: _____

Chapter 5
Study Guide

1. The primary purpose of the ignition system of a small gasoline engine is to provide sufficient _____ _____ to discharge a spark between the electrodes of the spark plug.

2. _____ are self-contained units that produce electrical current for ignition without any outside primary source of electricity.

3. All matter is composed of _____.

4. It is the smallest particle of an element that can exist, alone or in combination, yet it consists of _____, _____ and _____.

5. A _____ is made up of an electron and protron bound tightly together.

6. An electrical potential is produced in three ways:
   1. _____
   2. _____
   3. _____

7. The three basic units of electrical measurement are:
   1. _____-_____
   2. _____-_____
   3. _____-_____

8. An ampere is a _____ of the number of electrons flowing past any given point in a specific length of time.

9. _____ is the force, or potential, that causes the electrons to flow.

10. The fact that there is a close relationship between _____and _____ serves as the basis for making a workable magneto.

11. An important principle used in magneto construction is that a _____ _____ is developed when electrons flow through a coil of wire.

12. In _____ _____, an electrical current is passed through a coil which develops a magnetic field.

13. The ignition coil used in a magneto operates like a _____.

14. _____ is the tendency for current to travel down the outside of the spark plug instead of through the center electrode.

15. The _____ _____ generally consist of two tungsten contacts.

16. _____ supply the ignition spark on most small engines.

Name: _____

Small Engines
Ch. 5 Study Guide cont'd.

17. Magnets usually are cast into the flywheel and cannot be removed. They are strong permanent magnets made of _____(aluminum, nickel, cobalt alloy) or of a newer ceramic magnetic material.

18. The spark plug can only fire when the ignition points open the _____ _____.

19. Dwell (cam angle) is the time the breaker points stay closed during one _____ of the cam.

20. The _____ is the sole source of energy for the battery ignition system of a small gasoline engine.

21. A _____ is used to replenish energy in the battery.

22. A _____ _____ causes each negative plate to lose electrons and each positive plate to gain electrons when surrounded by electrolyte.

SMALL ENGINES - CH.5 STUDY GUIDE

ANSWERS

1. electrical voltage
2. Magnetos
3. atoms
4. electrons, protons, neutrons
5. neutron
6. 1. Mechanically
   2. Chemically
   3. Statically
7. 1. Amperes - rate of electron flow
   2. Volts - force that causes electrons to flow
   3. Ohms - resistance to electron flow
8. measurement
9. Voltage
10. electricity, magnetism
11. magnetic field
12. magneto operation
13. transformer
14. Flashover
15. breaker points
16. Magnetos
17. Alnico
18. primary circuit
19. revolution
20. battery
21. generator
22. chemical reaction

Name: _____

Study Guide
Ch. 6
Small Engines

1. _____ is the process of reducing friction between sliding surfaces, by introducing a slippery or smooth substance between them.

2. _____ is the resistance to motion created when one dry surface rubs against another.

3. Babbitt is an _____ of tin, copper and antimony, which has good anti-friction qualities.

4. Regardless of the quality of the material used, all bearing surfaces in small gasoline engines must have oil separating moving parts that are in _____ _____.

5. Oil performs a number of important jobs. Four of them are:
   1. _____
   2. _____
   3. _____
   4. _____

6. What do the following abreviations stand for?
   1. API _____
   2. SAE _____

7. _____, refers to resistance of a fluid flow, and it is rated in SAE numbers such as "SAE 10".

8. "Cold running" can result in scored _____ _____ and engine bearings.

9. Detergent-dispersants, ofter called "_____" are added to some oils.

10. Small gasoline engines generally use some type of "_____ _____" to lubricate internal machined surfaces.

11. The constant level splash system provides three major improvements over the simple splash system:
    1. _____
    2. _____
    3. _____

12. The ejection pump forces oil under pressure against the rotating _____ _____.

13. A full pressure lubrication system is the type used in _____ engines.

Name: _____

Small Engines
Ch. 6 Study Guide cont'd.

14. _____ trap dirt, carbon, and other harmful materials and prevent them from circulating through the engine.

SMALL ENGINES - CH.6 STUDY GUIDE

ANSWERS

1. Lubrication

2. Friction

3. alloy

4. close contact

5. 1. lubricates
   2. helps cool engine
   3. cleans engine
   4. provides a seal between the piston rings & cylinder wall

6. 1. American Petroleum Institute
   2. Society of Automotive Engineers

7. Viscosity

8. cylinder walls

9. detergents

10. splash system

11. 1. a pump
    2. a splash trough
    3. a strainer

12. connecting rod

13. automobile

14. Filters

Name: _____

Study Guide Ch. 7
Small Engines

1. _____ is required because the average temperature of burned gases in the combustion chamber of an air-cooled engine is about 3600 F.

2. Conduction is heat transfer through a _____ _____.

3. _____ occurs when heat transfers through movement of gas - in this case air.

4. As noted earlier, the _____ _____ carries away approximately a third of the engine heat.

5. Keeping an engine _____, _____ and properly _____ will significantly extend its life.

6. _____ is an excellent medium for cooling engines.

7. Some small outboard engines use a simple cooling device called a _____-_____ water flow system.

8. _____ _____ is the tendency of spinning matter to move away from the center of its path.

9. Radiators are _____ for water made of many thin copper or aluminum tubes.

10. Engines cooled by radiators also have _____ which open when the proper operating temperature is reached.

11. Oil circulating through the engine also acts as a _____.

SMALL ENGINES - CH.7 STUDY GUIDE

ANSWERS

1. Cooling
2. solid material
3. Convention
4. exhaust system
5. clean, cool, lubrication
6. Water
7. pressure - vacuum
8. Centrifugal force
9. Reservoirs
10. thermostats
11. coolant

Name: _____

Study Guide Ch. 8
Small Engines

1. The small gasoline engine belongs in the "_____ _____" category.

2. Engine "bore" is the _____ or width across the top of the cylinder.

3. "Stroke" is the up or down movement of the _____.

4. When the bore diameter is the same as the stroke, the engine is referred to as _____.

5. Engine size or _____, in a single cylinder engine, refers to the total volume of space increase in the cylinder as the piston moves from the top to the bottom of its stroke.

6. _____ is the pushing or pulling of one body on another.

7. The greater the force applied to the _____, the greater the amount of power and work that can be done by the engine.

8. _____ is a force per given unit of area.

9. Work is accomplished only when a force is applied through some _____.

10. Power is the _____ at which work is performed.

11. _____ is the capacity to perform or do work.

12. Write down the 5 types of energy.
    1. _____ 4. _____
    2. _____ 5. _____
    3. _____

13. Matter and energy cannot be _____.

14. _____ is a twisting or turning force.

SMALL ENGINES - CH.8 STUDY GUIDE

ANSWERS

1. heat engine
2. diameter
3. piston
4. square
5. displacement
6. Force
7. piston
8. Pressure
9. distance
10. rate
11. Energy
12. 1. Potential
    2. Kinetic
    3. Mechanical
    4. Chemical
    5. Thermal
13. destroyed
14. Torque

Name: _____

Study Guide Ch. 9
Small Engines

1. _____ is just a number of tests and steps gone through to find the problem.

2. A _____ _____ chart lists the most common chronic troubles along with possible causes and suggested remedies.

3. Most _____ have two needle valve adjustments.

4. Operating the engine with leaking reeds will result _____ _____, _____ _____ and _____ of the engine

5. The carburetor _____ _____ should be cleaned before each season and at regular intervals.

6. Only two types of _____ are used on engines - air-vane and centrifugial flyweights.

7. Engines equipped with compression release camshafts may have to be cranked in _____ _____ to obtain an accurate test.

8. Cleaning a small air-cooled engine periodically can prevent _____.

9. Engine oil does not "_____ _____".

10. _____ _____ is that condition when the oil cannot absorb any more contaminants and still be an effective lubricant.

11. _____ forms in partially filled containers because of temperature changes.

12. Outboards used in salt water should be removed from the water _____ after operation.

SMALL ENGINES - CH.9 STUDY GUIDE

ANSWERS

1. Analysis
2. troubleshooting
3. carburetors
4. fuel starvation, poor lubrication, overheating
5. air cleaner
6. governors
7. reverse rotation
8. overheating
9. wear out
10. Loaded oil
11. Condensation
12. immediately

Name: _____

Ch. 10 Study Guide
Small Engines

1. A _____ involves the entire - ignition system from coil windings to spark plugs.

2. Never use the _____ _____ as a knock-off tool or the crankshaft threads will be damaged.

3. Ignition spark occurs at the instant the _____ _____ open.

4. A condenser is a container for storing _____.

5. Only _____ current can be used to recharge a battery.

6. Never reverse _____ when servicing the battery.

7. Small engines having more than one cylinder and a battery ignition system must use a _____ to bring spark to the right cylinder at the right time.

SMALL ENGINES - CH.10 STUDY GUIDE

ANSWERS

1. tune-up
2. flywheel nut
3. breaker points
4. electricity
5. direct
6. polarity
7. distributor

Name: _____

Ch. 11 Study Guide
Small Engines

1. You will need a _____ _____ for the engine you are working on.

2. _____ the job saves time and effort.

3. Keeping the work _____ is part of good organization.

4. Finding the amount of _____ _____ is the first important measurement in determining cylinder condition.

5. _____ is an abrasive (sandpaper - like) finishing process which removes the boring tool marks and surface fractures.

6. After reboring and honing the cylinder, use a piece of fine _____ _____ to remove any burrs that may have developed around ports.

SMALL ENGINES - CH. 11 STUDY GUIDE

ANSWERS

1. service manual
2. Organizing
3. clean
4. cylinder taper
5. Honing
6. emery cloth

Name: _____

Ch. 12 Study Guide
Small Engines

1. In normal operation, the _____ travels up and down in the cylinder more than a thousand times per minute.

2. Pistons can be made of _____ or _____.

3. The section of the piston surrounding the piston pin hole is called the _____ _____.

4. The piston _____ is the part from the bottom of the lower ring groove on down.

5. The piston is subjected to high-temperatures, causing it to _____ during operation.

6. During the compression stroke, the pressure of the confined _____ _____ forces the piston toward one side of the cylinder.

7. In each instance, the sides of the piston forced against the cylinder wall are called _____ _____.

8. The piston head receives the brunt of _____ _____, so it runs hotter than the skirt and expands more.

9. Piston rings are made of _____ _____ or _____.

10. Piston rings must have the right amount of side clearance, which permits them to move in and out in the groove while exerting _____ on the cylinder wall.

11. _____ _____ are designed to provide a strong seal.

12. The oil control rings are designed to remove _____ _____ from the cylinder wall.

13. _____ is the process in which the face of each ring wears off until it is a perfect fit against the cylinder wall.

14. A piston pin is used to secure the _____ _____ to the piston.

SMALL ENGINES - CH.12 STUDY GUIDE

ANSWERS

1. piston
2. aluminum, steel
3. pin boss
4. skirt
5. expand
6. air-fuel mixture
7. thrust surfaces
8. combustion heat
9. cast iron, steel
10. tension
11. Compression rings
12. surplus oil
13. Wear-in
14. connecting rod

Name: _____

Ch. 13 Study Guide
Small Engines

1. Precision inserts must be kept in _____ _____.

2. Always tighten rod fasteners with a _____ _____ no more and no less than the amount of torque tightness specified.

3. The crankshaft converts the reciprocating (_____and _____) motion of the piston into rotary (_____) motion.

4. The connecting rod journal is commonly referred to as the "_____ _____" or "_____".

5. _____ _____ is the space left between the inner bearing surface and the crankshaft main or rod journal.

6. Heavy carbon deposits on intake valves sometimes cause faulty valve operation by _____ the flow of fuel into the cylinder.

7. _____ _____ refers to the space between the end of the valve stem and the top of the valve lifter when the valve is closed.

8. The _____ of an engine is designed to operate the valves.

9. To make hand cranking less of an effort, some small engines have an automatic _____ release mechanism on the camshaft.

10. _____ _____ is one of many advances in small engines that eases the chore of engine start-up.

SMALL ENGINES - CH.13 STUDY GUIDE

ANSWERS

1. matched pairs
2. torque wrench
3. back and forth, circular
4. crank throw, crank-pin
5. Bearing clearance
6. restricting
7. Valve clearance
8. camshaft
9. compression
10. Compression release

Name: _____

Ch. 14 Study Guide
Small Engines

1. Most small gasoline engines in use today are of the _____ _____ type.

2. Wankel engines are known by other names:
   1. _____
   2. _____
   3. _____

3. Actually, three _____, three _____, three _____ and three _____ actions take place during the one revolution of the rotor.

4. The rotary can be either _____ or _____.

5. Heat is controlled by circulating ccol _____ from the sump.

6. Lubricating oils in rotaries are not contaminated by _____.

7. Write down 2 advantages and 2 disadvantages of rotary engines.

SMALL ENGINES - CH. 14 STUDY GUIDE

ANSWERS

1. reciprocating piston
2. 1. rotary engines
   2. rotating combustion engines
   3. R.C. engine
3. intake, compression, power, exhaust
4. air-cooled, water-cooled
5. oil
6. blow-by
7.

Cloze Exercises

PAGE 1

OCCUPATIONAL READING MODULES

OSWEGO COUNTY B.O.C.E.S.

STATE PROJECT #81-3A-9111GS

PROGRAM COORDINATOR:

KATHY FINNERTY

AREA CONSULTANT:

GEORGE BELL

PROGRAMMERS:

JIM HURD

MARY KAY MCGIFF

****

PAGE 2

READ THE ENTIRE PASSAGE CAREFULLY.
USE THE WORDS SURROUNDING THE
BLANK TO HELP YOU FIGURE OUT THE
UNKNOWN WORD.

GE 3

HERE ARE SOME HINTS TO HELP YOU
FIND THE UNKNOWN WORD.

1. LOOK FOR WORDS LIKE 'AND, ALSO,
   TOO, LIKE, LIKEWISE, SUCH AS,
   FOR EXAMPLE, AND SIMILARLY'.

THESE WORDS ARE HINTS TO TELL YOU
THE WORD YOU ARE LOOKING FOR IS
'SIMILAR' OR 'LIKE'. OTHER WORDS IN
THE SENTENCE.

****

GE 4

EXAMPLE:

THE FUEL LINES CAN BE MADE FROM
STEEL, NEOPREME, PLASTIC AND OTHER
-----.

A. MACHINES B. DREAMS
C. MATERIALS D. PLACES

PAGE 5

EXAMPLE:

THE FUEL LINES CAN BE MADE FROM STEEL, NEOPREME, PLASTIC AND OTHER MATERIALS.

THE BEST ANSWER IS (C) MATERIALS. THE WORDS 'AND OTHER' TELL YOU TO LOOK FOR A WORD THAT DESCRIBES STEEL AND PLASTIC. THEY ARE BOTH KINDS OF MATERIALS.

****

PAGE 6

2. LOOK FOR WORDS SUCH AS 'BUT, UNLIKE, CONVERSELY, INSTEAD, HOWEVER, AND OR'.

THESE WORDS ARE HINTS TO TELL YOU THE WORD YOU ARE LOOKING FOR IS DIFFERENT THAN THE OTHER WORDS IN THE SENTENCE.

PAGE 7

EXAMPLE:

FIFTY YEARS AGO, MECHANICAL TYPE BRAKES WERE USED ON ALL CARS. TODAY, HOWEVER, MECHANICAL BRAKES ARE ----- SEEN ON CARS.

A. FREQUENTLY B. SELDOM

C. USUALLY D. ALWAYS

****

PAGE 8

EXAMPLE:

FIFTY YEARS AGO, MECHANICAL TYPE BRAKES WERE USED ON ALL CARS. TODAY, HOWEVER, MECHANICAL BRAKES ARE SELDOM SEEN ON CARS.

THE ANSWER IS (B) SELDOM. THE WORD 'HOWEVER' TELLS YOU TO LOOK FOR A WORD THAT MEANS THE OPPOSITE OF ALWAYS.

PAGE 9

3. LOOK FOR WORDS SUCH AS 'IF, THEN, BECAUSE, THEREFORE, AND CONSEQUENTLY'.

THESE WORDS ARE HINTS TO TELL YOU A CAUSE AND EFFECT. THESE WORDS WILL TELL YOU WHAT HAPPENS AND THE REASON WHY THEY HAPPENED.

****

PAGE 10

EXAMPLE:

IF A TIRE IS OVER-INFLATED, THEN THE TIRE WILL -----.

A. BURST B. HOLD

C. RIDE D. MARK

AGE 11

EXAMPLE:

IF A TIRE IS OVER-INFLATED, THEN THE TIRE WILL BURST.

THE ANSWER IS (A) BURST. THE WORDS 'IF' AND 'THEN' TELL YOU TO LOOK FOR SOMETHING TO HAPPEN AS A RESULT OF SOMETHING ELSE. IF A LOT OF AIR IS IN A TIRE, IT WILL CAUSE THE TIRE TO EXPLODE, OR BURST.

****

AGE 12

4. TO FIND THE MEANING OF A WORD YOU DO NOT KNOW, LOOK AT THE WORDS AROUND THE UNKNOWN WORD. THIS IS CALLED USING THE CONTEXT. OTHER WORDS IN THE SENTENCE MAY HELP YOU FIND A WORD MEANING.

PAGE 13

EXAMPLE:

ON THE COMPRESSION STROKE, THE
PISTON MOVES UP AND COMPRESSES OR
----- THE AIR AND GAS MIX.

A. CORRECTED B. RESULTS
C. TEMPERATURE D. SQUEEZES

****

PAGE 14

EXAMPLE:

ON THE COMPRESSION STROKE, THE
PISTON MOVES UP AND COMPRESSES OR
SQUEEZES THE AIR AND GAS MIX.

THE BEST ANSWER IS (D) SQUEEZES.
THE WORD COMPRESS MEANS TO
SQUEEZE.

PAGE 15

5. READ THE SENTENCES BEFORE AND
   AFTER THE BLANK TO MAKE SURE
   YOUR ANSWER MAKES SENSE.

****

PAGE 16

EXAMPLE:

IF AN ENGINE OVERHEATS, IT COULD
BURN UP COSTLY ENGINE PARTS. SO
THE COOLING SYSTEM IS USED TO GET
----- OF THE EXCESS HEAT.

A. HOLD B. RUNNING
C. RID D. FEAR

PAGE 17

EXAMPLE:

IF AN ENGINE OVERHEATS, IT COULD BURN UP COSTLY ENGINE PARTS. SO THE COOLING SYSTEM IS USED TO GET RID OF THE EXCESS HEAT.

THE BEST ANSWER IS (C) RID. TO AVOID OVERHEATING AN ENGINE, IT NEEDS A COOLING SYSTEM TO GET RID OF THE HEAT. USE OTHER WORDS TO GUESS MEANING OF THE CLUES.

****

AGE 18

6. LOOK AT THE CLUES WITHIN THE SENTENCE. ADD THE CLUES IN THE SENTENCE TO WHAT YOU ALREADY KNOW. THEN MAKE AN 'EDUCATED' GUESS ABOUT THE MEANING OF THE CLUES.

PAGE 19

EXAMPLE:

LIQUIDS DO NOT HAVE A SHAPE OF THEIR OWN. THEY CONFORM TO THE SHAPE OF THE ----- THEY'RE IN.

A. SYSTEM B. GROUND

C. CONTAINER D. CHAIR

****

PAGE 20

EXAMPLE:

LIQUIDS DO NOT HAVE A SHAPE OF THEIR OWN. THEY CONFORM TO THE SHAPE OF THE CONTAINER THEY'RE IN.

THE CORRECT ANSWER IS (C) CONTAINER. THE WORDS 'THEY'RE IN' AND 'CONFORM TO THE SHAPE OF', ARE CLUES TO TELL YOU THE LIQUID MUST BE IN A CONTAINER.

PAGE 21

	ANSWERS	PAGE REF.
1	C	3
2	B	6
3	A	9
4	D	12
5	C	15
6	C	18

PAGE 1

OPERATING PRINCIPLES

READ THE ENTIRE PASSAGE CAREFULLY. USE THE WORDS SURROUNDING THE BLANK TO HELP YOU FIGURE OUT THE UNKNOWN WORD.

****

PAGE 2

HERE ARE SOME HINTS TO HELP YOU FIND THE UNKNOWN WORD.

1. LOOK FOR WORDS LIKE 'AND, ALSO, TOO, LIKE, LIKEWISE, SUCH AS, FOR EXAMPLE AND SIMILARLY'.

THE WORDS ARE HINTS TO TELL YOU THE WORD YOU ARE LOOKING FOR IS 'SIMILAR' OR 'LIKE' OTHER WORDS IN THE SENTENCE.

PAGE 3

2. LOOK FOR WORDS SUCH AS 'BUT, UNLIKE, CONVERSELY, INSTEAD, HOWEVER AND OR'.

THESE WORDS ARE HINTS TO TELL YOU THE WORDS YOU ARE LOOKING ARE DIFFERENT THAN THE OTHER WORDS IN THE SENTENCE.

****

PAGE 4

3. LOOK FOR WORDS SUCH AS 'IF, THEN, BECAUSE, THEREFORE AND CONSEQUENTLY'.

THESE WORDS ARE HINTS TO TELL YOU A CAUSE AND EFFECT. THESE WORDS WILL TELL YOU WHAT HAPPENS AND THE REASONS WHY THEY HAPPEN.

PAGE 5

4. TO FIND THE MEANING OF A WORD YOU DO NOT KNOW, LOOK AT THE WORDS AROUND THE UNKNOWN WORD. THIS IS CALLED USING THE CONTEXT. OTHER WORDS IN THE SENTENCE MAY HELP YOU FIND A WORD MEANING.

****

PAGE 6

5. READ THE SENTENCES BEFORE AND AFTER THE BLANK TO MAKE SURE YOUR ANSWER MAKES SENSE.

PAGE 7

6. LOOK AT THE CLUES WITHIN THE SENTENCE. ADD THE CLUES IN THE SENTENCE TO WHAT YOU ALREADY KNOW. THEN MAKE AN 'EDUCATED' GUESS ABOUT THE MEANINGS OF THE CLUES.

****

PAGE 8

OPERATING PRINCIPLES - QUESTIONS

1. THE BEARINGS MUST BE HELD IN PLACE, SO THEY WILL NOT ----- BETWEEN THE TWO MOVING PARTS. THEY ARE LOCKED IN PLACE BY USING A LOCKING LIP OR DOWEL HOLE. THE LIP FITS INTO A LIP SLOT, OR THE DOWEL HOLE FITS OVER A DOWEL PIN.

   A. SLIP B. FIT

   C. BLEED D. PERFORM

PAGE 9

2. THE VALVES OF THE ENGINE MUST OPEN AND CLOSE AT THE RIGHT ----- FOR THE ENGINE TO RUN. THE INTAKE MUST OPEN ON THE INTAKE STROKE. BOTH VALVES MUST SEAL THE CYLINDER ON THE COMPRESSION STROKE AND THE POWER STROKE. THE EXHAUST VALVE MUST OPEN ON THE EXHAUST STROKE.

A. POSITION B. PLACE

C. POINT D. TIME

****

PAGE 10

3. THE DIESEL ENGINE USES AN INJECTOR TO SPRAY THE DIESEL FUEL INTO THE CYLINDER. THE INJECTOR SPRAYS THE FUEL IN TINY PARTICLES WHICH ENTER THE CYLINDER LIKE A -----. THIS MIST BURNS RAPIDLY WHEN HEATED TO HIGH TEMPERATURES IN THE CYLINDER, WHICH CREATES AN EXPLOSION AND CAUSES THE POWER STROKE OF THE ENGINE.

A. STREAM B. ROCK

C. MIST D. BRANCH

PAGE 11

4. AN AUTOMOBILE GASOLINE ENGINE MAY HAVE FOUR, SIX OR EIGHT CYLINDERS, BUT THE PRINCIPLE OF OPERATION IS THE ----- FOR EACH. A MIXTURE OF AIR AND GAS IS COMPRESSED IN THE CYLINDER BY THE PISTON, THEN IGNITED BY A SPARK.

A. DIFFERENT B. MIXTURE

C. POWER D. SAME

****

PAGE 12

5. THE PISTON MOVES UP AND DOWN, BUT THE CYLINDER REMAINS -----.

A. POWERFUL B. STATIONARY

C. ACCOMPLISHED D. DOWNWARD

PAGE 13

	ANSWERS	PAGE REF.
1	A	7
2	D	5
3	C	2
4	D	3
5	B	3

PAGE 1

COOLING SYSTEM

READ THE ENTIRE PASSAGE CAREFULLY. USE THE WORDS SURROUNDING THE BLANK TO HELP YOU FIGURE OUT THE UNKNOWN WORD.

****

PAGE 2

HERE ARE SOME HINTS TO HELP YOU FIND THE UNKNOWN WORD.

1. LOOK FOR WORDS LIKE 'AND, ALSO, TOO, LIKE, LIKEWISE, SUCH AS, FOR EXAMPLE AND SIMILARLY'. THE WORDS ARE HINTS TO TELL YOU THE WORD YOU ARE LOOKING FOR IS 'SIMILAR' OR 'LIKE' OTHER WORDS IN THE SENTENCE.

PAGE 3

2. LOOK FOR WORDS SUCH AS 'BUT, UNLIKE, CONVERSELY, INSTEAD, HOWEVER AND OR'.

THESE WORDS ARE HINTS TO TELL YOU THE WORD YOU ARE LOOKING FOR IS DIFFERENT THAN THE OTHER WORDS IN THE SENTENCE.

****

PAGE 4

3. LOOK FOR WORDS SUCH AS 'IF, THEN, BECAUSE, THEREFORE AND CONSEQUENTLY'.

THESE WORDS ARE HINTS TO TELL YOU A CAUSE AND EFFECT. THESE WORDS WILL TELL YOU WHAT HAPPENS AND THE REASONS WHY THEY HAPPEN.

PAGE 5

4. TO FIND THE MEANING OF A WORD YOU DO NOT KNOW, LOOK AT THE WORDS AROUND THE UNKNOWN WORD. THIS IS CALLED USING THE CONTEXT. OTHER WORDS IN THE SENTENCE MAY HELP YOU FIND A WORD MEANING.

****

PAGE 6

5. READ THE SENTENCES BEFORE AND AFTER THE BLANK TO MAKE SURE YOUR ANSWER MAKES SENSE.

PAGE 7

6. LOOK AT THE CLUES WITHIN THE SENTENCE. ADD THE CLUES IN THE SENTENCE TO WHAT YOU ALREADY KNOW. THEN MAKE AN 'EDUCATED' GUESS ABOUT THE MEANING OF THE CLUES.

****

PAGE 8

COOLING SYSTEM - QUESTIONS

1. A COOLING SYSTEM IN AN ENGINE HELPS TO PREVENT THE ENGINE FROM BECOMING TOO ----- AND IT ALSO HELPS CONTROL ENGINE TEMPERATURE. THE EFFICIENCY AND LIFE OF AN ENGINE DEPENDS UPON HOW WELL IT IS COOLED.

   A. TIRED B. HOT

   C. COLD D. UNUSED

PAGE 9

2. FUEL BURNS IN THE CYLINDER AT AN EXTREMELY HOT TEMPERATURE, ABOUT 3,000 DEGREES FAHRENHEIT. AFTER A FEW MINUTES OF RUNNING WITHOUT COOLING, THE ENGINE WOULD BECOME RED HOT. IF THE ENGINE CONTINUED TO RUN AT THIS VERY HIGH TEMPERATURE, IT WOULD SOON BE -----.

A. FIXED B. SERVICED

C. CLEANED D. DESTROYED

****

PAGE 10

3. MOST ENGINE HEAT COMES FROM THE CYLINDER OR COMPRESSION AND POWER STROKES. A LOT OF THIS HEAT IS TAKEN ----- WITH THE EXHAUST GASES. THE CYLINDER AND VALVES ALSO ABSORB MUCH HEAT, AND THEY MUST BE COOLED BEFORE THEY BECOME DAMAGED.

A. AWAY B. CAPTIVE

C. OFF D. FORWARD

PAGE 11

4. A WATER JACKET SURROUNDS THE ENGINE BLOCK. THE WATER FLOWING IN THE WATER JACKET PICKS UP HEAT IN THE BLOCK AND CARRIES THAT HEAT TO THE RADIATOR. AS THE WATER ----- FROM THE TOP TANK TO THE BOTTOM TANK, THE HEAT IN THE WATER IS ABSORBED BY RADIATOR FINS. SINCE THE FAN IS PULLING COOL AIR PAST THE RADIATOR FINS, HEAT FROM THE FINS IS TRANSFERRED TO THE AIR AND THE HOT AIR IS BLOWN AWAY.

A. SEPARATES B. SETTLES

C. CIRCULATES D. TRANSFERS

****

PAGE 12

5. MOST ENGINES ARE DESIGNED TO RUN WITHIN A TEMPERATURE RANGE. A THERMOSTAT IS INSTALLED IN THE COOLING SYSTEM. THE THERMOSTAT IS MADE TO OPEN THE PASSAGE TO ALLOW WATER TO FLOW THROUGH THE RADIATOR WHEN THE ENGINE TEMPERATURE IS AT, OR ABOVE THE OPERATING TEMPERATURE RANGE. HOWEVER, WHEN THE THERMOSTAT IS ----- THE COOLANT IS CIRCULATED BYPASSING THE RADIATOR IN A SMALL LOOP AROUND THE CYLINDER BLOCK.

A. OPENED B. DECREASED

C. UPSET D. CLOSED

6. SOME TRUCKS HAVE SHUTTERS OR FINS ON THE FRONT OF THE RADIATOR. IF THE ENGINE IS COOL, THE SHUTTERS ARE CLOSED TO PREVENT AIR FROM PASSING THROUGH THE RADIATOR. WHEN THE ENGINE TEMPERATURE ----- TO OPERATING LIMITS, THE SHUTTERS OPEN AND ALLOW AIR TO PASS THROUGH THE RADIATOR.

A. INCREASED B. DECREASED

C. CHANGES D. OPENS

****

	ANSWERS	PAGE REF.
1	B	7
2	D	4
3	A	7
4	C	7
5	D	3
6	A	6

PAGE 1

HYDRAULICS

READ THE ENTIRE PASSAGE CAREFULLY. USE THE WORDS SURROUNDING THE BLANK TO HELP YOU FIGURE OUT THE UNKNOWN WORD.

****

PAGE 2

HERE ARE SOME HINTS TO HELP YOU FIND THE UNKNOWN WORD.

1. LOOK FOR WORDS LIKE 'AND, ALSO, TOO, LIKE, LIKEWISE, SUCH AS, FOR EXAMPLE AND SIMILARLY'. THE WORDS ARE HINTS TO TELL YOU THE WORD YOU ARE LOOKING FOR IS 'SIMILAR' OR 'LIKE' OTHER WORDS IN THE SENTENCE.

PAGE 3

2. LOOK FOR WORDS SUCH AS 'BUT, UNLIKE, CONVERSELY, INSTEAD, HOWEVER AND OR'.

THESE WORDS ARE HINTS TO TELL YOU THE WORD YOU ARE LOOKING FOR IS DIFFERENT THAN THE OTHER WORDS IN THE SENTENCE.

****

PAGE 4

3. LOOK FOR WORDS SUCH AS 'IF, THEN, BECAUSE, THEREFORE AND CONSEQUENTLY'.

THESE WORDS ARE HINTS TO TELL YOU A CAUSE AND EFFECT. THESE WORDS TELL YOU WHAT HAPPENS AND THE REASONS WHY THEY HAPPEN.

PAGE 5

4. TO FIND THE MEANING OF YOU DO NOT KNOW, LOOK AT THE WORDS AROUND THE UNKNOWN WORD. THIS IS CALLED USING THE CONTEXT. OTHER WORDS IN THE SENTENCE MAY HELP YOU FIND A WORD MEANING.

****

PAGE 6

5. READ THE SENTENCES BEFORE AND AFTER THE BLANK TO MAKE SURE YOUR ANSWER MAKES SENSE.

6. LOOK AT THE CLUES WITHIN THE SENTENCE. ADD THE CLUES IN THE SENTENCE TO WHAT YOU ALREADY KNOW. THEN MAKE AN 'EDUCATED' GUESS ABOUT THE MEANING OF THE CLUES.

****

PAGE 8

HYDRAULICS - QUESTIONS

1. LIQUIDS DO NOT HAVE A SHAPE OF THEIR OWN. THEY ----- TO THE SHAPE OF THE CONTAINER IN WHICH THEY ARE STORED.

A. GROW B. CONNECT

C. CONFORM D. REDUCE

PAGE 9

2. LIQUIDS CAN NOT BE SQUEEZED OR -----.

A. COMPRESSED

B. DOUBLED

C. REPAIRED

D. CONVERTED

****

PAGE 10

3. HYDRAULIC CYLINDERS PROVIDE THE MECHANICAL FORCE TO GET WORK DONE. THEY CHANGE OR ----- HYDRAULIC POWER AND MOVEMENT.

A. REMOVE

B. ATTRACT

C. REPAIR

D. CONVERT

4. THERE ARE TWO TYPES OF PUMPS USED IN HYDRAULIC SYSTEMS, POSITIVE AND VARIABLE DISPLACEMENT PUMPS. THE POSITIVE DISPLACEMENT PUMP WILL DISPLACE A QUANTITY OF OIL EACH TIME THE PUMP MAKES ONE REVOLUTION. POSITIVE DISPLACEMENT PUMPS ARE USED IN THE OPEN CENTER HYDRAULIC SYSTEM. A VARIABLE DISPLACEMENT PUMP IS ONE IN WHICH DISPLACEMENT (OIL PUSHED OUT) CAN BE -----. THE VARIABLE DISPLACEMENT PUMP IS USED IN A CLOSED CENTER HYDRAULIC SYSTEM.

A. FIXED B. CHANGED

C. FEATURED D. POSITIVE

****

5. A HYDRAULIC SYSTEM THAT IS USED ON PRACTICALLY EVERY CAR OR TRUCK MADE IS THE FUEL DELIVERY SYSTEM. THIS SYSTEM MOVES ----- OR DIESEL FUEL FROM THE GAS TANK TO THE CARBURETOR OR INJECTION PUMP.

A. GASOLINE B. HYDRAULIC

C. OIL D. VALVES

PAGE 13

	ANSWERS	PAGE REF.
	C	7
2	A	5
3	D	5
	B	6
	A	5

Layout Design

Typist

Lou Ann Peet